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STATEMENT OF TECHNICAL REVIEW

Performance Work Statement for
Environmental Remediation Services at the Former Hanley Area
St. Louis Ordnance Plant, Missouri

Draft Final Decision Document, St. Louis Ordnance Plant, Former Hanley Area

The Conti/CH2M HILL Team has completed the technical review of the submittal of the Draft Final Decision Document. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures and material used in analyses; the appropriateness of data used and level of data obtained; and reasonableness of the results including whether the product meets the customer's needs consistent with the law and existing USACE policy.

Technical Reviewer	Signature	Date of Review
Susanne Borchert	S. Borchert	February 15, 2011

Quality Control System Manager (for QCP) or Project Manager	ITR Leader
Luis Seijido	Susanne Borchert
Signature	Signature
	S. Borchert

Draft Final Decision Document

St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

Prepared for
U.S. Army Corps of Engineers,
Kansas City District
Contract No. W912DQ-05-D-0002
Task Order No. 0007

February 2011

Prepared by

Conti

and

CH2MHILL

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Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
COC	chemical of concern
COPC	chemical of potential concern
CPT	cone penetrometer test
CT	carbon tetrachloride
cVOC	chlorinated volatile organic compound
1,2-DCA	1,2-dichloroethane
cis-1,2-DCE	*cis*-1,2-dichloroethene
trans-1,2-DCE	*trans*-1,2-dichloroethene
DAF	dilution-attenuation factor
DNAPL	dense nonaqueous phase liquid
Eco-SSL	ecological soil screening level
ELCR	excess lifetime cancer risk
FS	feasibility study
HHRA	human health risk assessment
HI	hazard index
ID	identification
LUC	land use control
MCL	maximum contaminant level
MDHSS	Missouri Department of Health and Senior Services
MDNR	Missouri Department of Natural Resources
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
MIP	membrane interface probe
MOU	Memorandum of Understanding
MSSL	medium-specific screening level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	operation and maintenance
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PRG	preliminary remediation goal
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
REMChlor	Remediation Evaluation Model for Chlorinated Solvents
RI	remedial investigation
RRC	Regional Readiness Command
RSC	Regional Support Command

SLAAP	St. Louis Army Ammunition Plant
SSL	soil screening level
SVOC	semivolatile organic compound
TAL	target analyte list
TCE	trichloroethene
TCH	thermal conductive heating
TeCA	tetrachloroethane
TTZ	target treatment zone
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1. Declaration

1.1 Site Name and Location

St. Louis Ordnance Plant, former Hanley Area
Army Reserve Facility identification number (ID) MO030
6400 Stratford Avenue
St. Louis, Missouri
Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) ID MO3210090038

1.2 Statement of Basis and Purpose

This decision document presents the selected final remedial action for the former Hanley Area of the St. Louis Ordnance Plant in St. Louis, Missouri. The U.S. Army chose the remedy with input and concurrence from the Missouri Department of Natural Resources (MDNR) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision document is based on the administrative record file for the former Hanley Area, which is maintained at the Julia Davis Branch Library, 4415 Natural Bridge Avenue, St. Louis, and available for public review. The U.S. Army will fulfill its responsibility and obligation under CERCLA and the NCP as it implements, maintains, and reviews the selected remedy.

1.3 Assessment of the Site

The response action selected in this decision document is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4 Description of Selected Remedy

The selected remedy for the former Hanley Area will address areas of soil and groundwater contamination that potentially pose unacceptable risks to human health. It consists of the following components:

- **Soil removal and offsite disposal**. During the remedial investigation phase, MDNR, Missouri Department of Health and Senior Services (MDHSS), U.S. Environmental Protection Agency (USEPA), and the U.S. Army agreed that certain areas of surface soil with elevated arsenic, lead, and Aroclor 1260 concentrations would be removed during the remedial action. Additional areas of surface soil contaminated with thallium were

identified during the feasibility study (FS) phase and will also be removed during the remedial action.

- **Removal and offsite disposal of sediment, if present, at 22 powder well locations**. The sediment will be transported to an offsite licensed disposal facility based on characterization sampling, and the wells will be backfilled with clean imported fill.
- **In situ groundwater treatment using chemical processes and soil mixing—Plume A**. The area of groundwater contamination posing an unacceptable risk to construction workers will be treated by applying a chemical reductant or oxidant to soil and groundwater in place. Mechanical mixing of the soil will be performed to distribute the chemical amendment through the soil column within the treatment zone.
- **Groundwater monitoring within Plume C, an area contaminated with carbon tetrachloride (CT)**. Data from groundwater monitoring will confirm that the exposure pathway between construction workers and contaminated groundwater remains incomplete because of the depth to the groundwater table.
- **Vapor intrusion evaluation.** Because of the uncertainty of indoor air risk to future offsite residents, the potential migration of contaminated vapors from groundwater to indoor air will be further assessed through a vapor intrusion evaluation. If the evaluation reveals that indoor vapor concentrations in offsite residences pose an unacceptable risk to the residents and are related to the former Hanley Area, appropriate response measures will be implemented by the U.S. Army.
- **Land use controls (LUCs)**. Unless future vapor intrusion evaluations confirm that risk thresholds have not been exceeded, an onsite LUC boundary will be established around the area where groundwater concentrations exceed screening levels, indicating possible vapor intrusion concerns. The LUCs will require vapor intrusion evaluations at future building construction sites at the former Hanley Area if groundwater concentrations have not fallen below screening levels in the vicinity of the construction site. If results of the vapor intrusion evaluation indicate potential vapor intrusion issues, or if a vapor intrusion evaluation is not performed, vapor intrusion mitigation technology will be applied to address soil gases that could enter the future building.

  Within the LUC area described above, a second LUC will be established over Plume C as long as CT concentrations remain above the groundwater preliminary remediation goal (PRG) established in the FS. The LUC will prohibit construction activities below the groundwater table without proper health and safety training and personal protective equipment.
- **Five-year site reviews.** Five-year reviews will be performed as long as hazardous substances remain at the site at concentrations that do not allow unlimited use and unrestricted exposure. The five-year reviews would be terminated once chemicals of concern (COCs) are at or below the remediation goals, the vapor intrusion pathway is determined not to cause unacceptable risk as part of a future vapor intrusion evaluation (or chemical concentrations in groundwater fall below screening levels), and monitoring confirms that no unacceptable risks are posed by Plume C.

This is the final remedy for the former Hanley Area and the final planned response action for the site.

Although it is not part of the selected remedy, City of St. Louis Ordinance 66777 provides protection against exposure to contaminated groundwater. The ordinance prohibits the use or attempted use of groundwater as a potable water supply and the drilling or installation of wells for a potable water supply within the corporate limits of the City of St. Louis.

1.5 Statutory Determinations

The selected remedy for the former Hanley Area meets the statutory requirements of CERCLA. It is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and uses permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected remedy satisfies the statutory preference for treatment as a principal element of the remedy.

Because the selected remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the remedial action. The reviews will continue at a minimum frequency of once every 5 years thereafter to ensure that the remedy remains protective of human health and the environment.

1.6 Decision Document Data Certification Checklist

The following information is included in the Decision Summary sections of this report:

- COCs and their respective concentrations
- Baseline risk represented by the COCs
- Cleanup levels established for COCs and the basis for these levels
- How source materials constituting principal threats are addressed
- Current and reasonably anticipated future land use assumptions, and current and hypothetical future beneficial uses of groundwater used in the baseline risk assessment and decision document
- Potential land and groundwater uses resulting from the selected remedy
- Estimated capital costs, annual operation and maintenance (O&M) costs, and total present worth; discount rate; and the number of years over which the remedy cost estimates are projected
- Key factors that led to remedy selection

1.7 Authorizing Signature

Scott D. Kimmel/Colonel, U.S. Army Date

2. Decision Summary for the Former Hanley Area

2.1 Site Name, Location, and Description

The former Hanley Area (Army Reserve Facility ID MO030, CERCLIS ID MO3210090038) is an industrial site that consists of 14.68 acres and is located at 6400 Stratford Avenue on the western boundary of the city limits of St. Louis, 0.25 mile south of the intersection of I-70 and Goodfellow Boulevard (Figure 2-1). The site is north of the Sverdrup U.S. Army Reserve Center (Facility ID MO028), located at 4301 Goodfellow Boulevard in St. Louis. The 89th Regional Readiness Command (RRC) owned the former Hanley Area until it was disestablished in June 2009. The 88th Regional Support Command (RSC) owns the former Hanley Area and occupies the Center.

The U.S. Army is the lead agency for the former Hanley Area. The U.S. Army Environmental Command (USAEC) is the Army agency responsible for cleanup activities at the site. The U.S. Army Corps of Engineers (USACE)–Kansas City District provides environmental technical assistance to the USAEC in support of their cleanup activities at this site. Through a U.S. Department of Defense State Memorandum of Agreement, USAEC works with the Federal Facilities section of MDNR on Defense Environmental Restoration Program properties in Missouri. USEPA Region 7 provides regulatory assistance to MDNR. Although the former Hanley Area is not on the National Priorities List, USACE follows the CERCLA process for responses to hazardous substances, pollutants, and contaminants as set forth in 10 United States Code 2701.

2.2 Site History and Enforcement Activities

2.2.1 Site History

The St. Louis Ordnance Plant operated from 1941 to 1945 as a small arms ammunition production facility, producing primarily .30- and .50-caliber ammunition. The plant was divided into two areas designated No. 1 (east of Goodfellow Boulevard) and No. 2 (west of Goodfellow Boulevard). Plant Area No. 2 encompassed 27.68 acres. The former Hanley Area consists of the 14.68 acres at the northeastern end of Plant Area No. 2 at the intersection of Stratford Avenue and Goodfellow Boulevard (Figure 2-2). Production at the latter plant consisted of blending primary explosives, incendiary compounds, and tracer charging .30- and .50-caliber projectiles as part of the assembly of the final product. Powder wells installed in 1941 received wastewater from buildings and magazines until 1945. The powder wells provided sediment collection before the wastewater was discharged to the sanitary sewer.

From 1945 through 1959, some buildings within Plant Area No. 2 were used by the U.S. Army Adjutant General's Office for maintaining service records. Other buildings within Plant Area No. 2 were used as classrooms by the U.S. Department of Defense Finance Center.

The Hanley Area takes its name from Hanley Industries, Inc., which leased 14.68 acres at the northeastern end of Plant Area No. 2 in 1959 and conducted operations there through 1979. Hanley used the site for research, development, manufacture, and testing of explosives. Over that time, Hanley produced specialty ordnance and nonordnance devices for the U.S. military and the National Aeronautics and Space Administration. Hanley used most of the buildings to load detonators and primers and to mix explosives. Explosives were dried in magazines by leaving cans of explosives exposed to the air, and a lead azide reactor was operated in one of the magazines, the location of which is unknown. Hanley reportedly did not use the powder wells or sumps on the property for wastewater disposal.

The Goodfellow U.S. Army Reserve Center (now the Sverdrup U.S. Army Reserve Center) was established on the remaining 13 acres of Plant Area No. 2. Some of the western parts of the 13 acres subsequently were transferred to the U.S. Department of Labor, and the land is currently occupied by the Job Corps. Most of the Hanley Area housed a series of warehouse buildings, bunkers, and related buildings. Between 2004 and 2007, buildings and bunkers, with the exception of Buildings 219A, 219D, 219G, and 236, were demolished by an 89th RRC contractor.

Soil and groundwater contamination observed at the former Hanley Area is suspected to be related to previous waste handling, generation, and disposal processes. The explosives manufacturing process may have resulted in metal contamination in soil, and laboratory and maintenance activities at former Building 220 may have released polycyclic aromatic hydrocarbons (PAHs) in soil and volatile organic compounds (VOCs) in soil and groundwater. A leaking transformer resulted in polychlorinated biphenyl (PCB) Aroclor 1260 contamination in surface soil.

The June 1981 U.S. Army Toxic and Hazardous Materials Agency *Survey of Hazardous Chemical Area No. 2 of the Former St. Louis Ordnance Plant* states that Hanley Industries, Inc., disposed of explosives-contaminated material by burning it in the basement of Building 218C between 1959 and 1979. Open burning of explosives was also conducted in magazines 219F and 219J.

2.2.2 Site Investigations

Environmental investigations at the former Hanley Area have been conducted since 1979. The investigation history and findings are summarized below.

2.2.2.1 Preliminary Assessments / Site Inspections

1979 and 1980—Site Investigation by Battelle Columbus Laboratories. The Battelle study was performed at the current site of the Job Corps Training Center and former Hanley Area. Existing buildings, magazines, sewer pipe locations, and powder wells were sampled and analyzed for explosives and metals to assess whether explosive and metal residues remained after previous decontamination efforts. Results indicated the presence of potential explosives and metals residues on building surfaces, in powder wells, and on other structures associated with munitions production, packing, or storage activities (U.S. Army Toxic and Hazardous Materials Agency [USATHAMA] 1981).

1991—Environmental Study by USATHAMA. Surface and shallow soil samples and tunnel water samples were collected. Lead concentrations in surface soil exceeded site-specific and regional background values. No explosives were detected in the soil samples. Semivolatile

organic compounds (SVOCs) were detected at five locations. The PCB Aroclor 1260 was detected in one soil sample at a concentration of 18,200 milligrams per kilogram (mg/kg) at the location of a former leaking transformer (USATHAMA 1991).

1998—Site Investigation by HARZA Environmental Services, Inc. The investigation assessed the presence of chemicals in soil and sediment. Surface and shallow soil samples were collected and analyzed for VOCs, SVOCs, explosives, and Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Subsurface soil, sewer sediment, and powder well sediment samples were collected and analyzed for explosives and RCRA metals. Explosives and elevated lead concentrations were detected in surface and shallow soil samples at one location. Arsenic concentrations ranging between 5.0 mg/kg and 67.7 mg/kg were also identified. Silver was found at a maximum concentration of 82.6 mg/kg in a shallow soil sample at one location (HARZA 1998).

2001—Draft Preliminary Assessment / Site Inspection by TapanAm Associates, Inc. The preliminary assessment/site inspection evaluated the extent of surface soil contamination, the potential for contaminant migration by surface routes through underground utility tunnels, and the potential for groundwater contamination. Surface soil, subsurface soil, sediment, and groundwater samples were analyzed for one or more of the following parameters: VOCs, explosives, and target analyte list (TAL) metals. Surface soil samples were collected in the northern part of the site around the Building 219 series. Subsurface soil samples were collected near sewer line breaks and two near powder wells. Direct-push probes/temporary piezometers were installed and groundwater samples were collected for chemical analysis. Five monitoring wells (MW-101 through MW-105) were installed and sampled. Sediment samples were also collected from powder wells, sewers, and tunnels. Water samples were collected from sewer locations.

Arsenic, lead, and thallium were found in soil samples at concentrations exceeding USEPA Region 9 PRGs for residential soil. No explosives were detected in surface soil, and no explosives or VOCs were detected in subsurface soil. Lead concentrations exceeding the PRG, as well as low concentrations of explosives, were found in powder well sediment. The VOC *cis*-1,2-dichloroethene (*cis*-1,2-DCE) was detected at a concentration slightly above the maximum contaminant level (MCL) in groundwater at one well, upgradient of the former Hanley Area. No other VOCs were detected at concentrations above the MCL, and no explosives were detected in groundwater (TapanAm 2001).

2003—Limited Phase II Environmental Site Assessment by Shaw Environmental, Inc. The environmental site assessment further assessed offsite upgradient VOC contamination found during the preliminary assessment/site inspection. Samples were collected from direct-push borings near the monitoring well to assess the presence of VOCs in soil. The borings were then converted to temporary monitoring wells to sample groundwater for VOCs. No VOCs were detected in subsurface soil. Concentrations of *cis*-1,2-DCE, *trans*-1,2-dichloroethene (*trans*-1,2-DCE), and vinyl chloride were detected in groundwater at direct-push sample location GP-4 (Shaw 2003).

2003—Phase I Environmental Site Assessment by Pangea, Inc. Asbestos samples were collected from onsite buildings during the Phase I environmental site assessment (Pangea 2003).

2.2.2.2 Remedial Investigations

2004—Sampling, Asbestos Abatement, and Building Demolition by SCS Engineers. Sediment samples and building materials were collected and analyzed for explosives and metals. Asbestos abatement was performed in the buildings, which were then demolished (SCS Engineers 2004).

2004—Environmental Data Compilation by USACE. USACE compiled environmental data from the previous investigations and identified data gaps (USACE 2005).

2005—Phase I Remedial Investigation by USACE. USACE performed a Phase I remedial investigation (RI) to fill data gaps. Composite and discrete surface soil samples were collected in areas where metals previously had been identified in surface soil. The samples were analyzed for TAL metals. Some of the samples were also analyzed for PAHs. Surface soil samples were collected for PCB analysis from the area of the former transformer, located near the southern site boundary. Subsurface soil samples were collected from soil borings advanced adjacent to powder wells, sewer lines, and foundations. One monitoring well was installed downgradient from former Building 220. The new well and five existing wells were sampled and analyzed for explosives, VOCs, and TAL metals.

Investigation results identified an area of localized PCB contamination near the former leaking transformer along the southern site boundary. Site-related metals were found to be localized and limited to surface and near-surface soil. Subsurface soil was not contaminated. Groundwater in the upgradient well, MW-101, was contaminated with benzene and the chlorinated VOCs (cVOCs) *cis*-1,2-DCE, *trans*-1,2-DCE, and trichloroethene (TCE). The newly installed well, MW-106, on the northern part of the site, exhibited detections of tetrachloroethene (PCE) and 1,2-dichloroethane (1,2-DCA). Various metals were also detected in groundwater (USACE 2005).

2005 and 2006—Supplemental Groundwater RI by USACE. In 2005, direct-push borings/temporary piezometers were installed and sampled near former Building 220 to assess the origin and extent of 1,2-DCA in groundwater in MW-106. Results indicated that groundwater was contaminated with PCE, TCE, CT, and chloroform. Based on these results, activities were conducted in February 2006 to assess the extent of groundwater contamination. Temporary piezometers were installed, and groundwater samples were collected. Existing monitoring wells were also sampled. Results from the temporary piezometers indicated the presence of PCE, TCE, *cis*-1,2-DCE, 1,2-DCA, and CT in groundwater. Benzene, *cis*-1,2-DCE, *trans*-1,2-DCE, TCE, and vinyl chloride were detected at upgradient well MW-101. PCE and 1,2-DCA were detected at MW-106. Various metals were detected in each monitoring well, but no explosives were detected.

Based the February 2006 findings, additional field activities were implemented in July 2006. Direct-push borings were advanced and groundwater samples collected around former Building 220. Samples were analyzed using field gas chromatography for VOCs and submitted for laboratory analysis. PCE, TCE, *cis*-1,2-DCE, chloroform, and 1,2-DCA were detected in the direct-push samples. The gas chromatography confirmed presence of cVOCs. Sediment samples were collected from the two sewer inlets that drain water from the concrete pad north of former Building 220. PCE was the only VOC detected in sediment (USACE 2006a, USACE 2006b).

2007—Supplemental Groundwater Phase II RI by USACE. Additional groundwater investigations were undertaken in January 2007. Membrane interface probes (MIPs) were advanced to top of bedrock, north and northeast of former Building 220 where previous direct-push probes showed high PCE and 1,2-DCA concentrations. Direct-push soil borings were advanced adjacent to and stepped out from the MIP locations for confirmation samples and to determine the extent of VOC contamination in the surface and subsurface soil. Eight monitoring wells (MW-107 through MW-114) were installed in the area northeast of Building 220 and along Stratford Avenue to monitor the interior and boundaries of the VOC contamination observed during the direct-push groundwater investigations.

Additional work was completed in March and April 2007. Soil borings were advanced in the affected area northeast of former Building 220. One monitoring well was installed upgradient of the affected area within the footprint of former Building 220. Groundwater samples were also collected from the eight new wells and one existing well, MW-106, and analyzed for VOCs. PCE and its breakdown products TCE, *cis*-1,2-DCE, and *trans*-1,2-DCE were present in each soil boring. PCE and its associated breakdown products were also detected beneath Stratford Avenue (USACE 2007).

2008—RI by CH2M HILL. The 2008 RI filled remaining data gaps and fully delineated the nature and extent of contamination at the site. Surface soil samples were collected to characterize lead and arsenic contamination and the surface soil. A MIP/cone penetrometer test (CPT) was used to characterize the nature and extent of VOC contamination in soil, soil gas, and groundwater in the area around former Building 220. Following the MIP/CPT investigation, confirmation soil and groundwater samples were collected based on the MIP/CPT data. Groundwater grab samples were collected from soil borings using results from the MIP investigation. To further define the nature and extent of cVOC groundwater contamination near and downgradient of former Building 220, one deep and two shallow groundwater monitoring wells were installed. Groundwater samples were collected from new and existing wells in the area of former Building 220 to confirm the extent of cVOC impact on groundwater at the north end of the site. Indoor air sampling was also performed in a residence along Stratford Avenue to assess the potential for vapor intrusion in residences north of the St. Louis Ordnance Plant (CH2M HILL 2009).

Results from the 2008 RI and previous investigations were presented and discussed in the RI report (CH2M HILL 2009). Human health and ecological risk assessments were performed and are presented in the RI report.

2010—Groundwater Predesign Investigation by CH2M HILL. A groundwater predesign investigation was performed to refine the groundwater target treatment zone (TTZ) in the north part of the former Hanley Area. The information will be used to develop the remedial design. Groundwater grab samples were collected from four soil borings to delineate the groundwater treatment area that will be addressed during the remedial design. One new monitoring well, MW-118, was installed in an area where CT contamination was observed in groundwater during the 2008 RI. Groundwater samples were collected from MW-106 through MW-116 and MW-118. 1,2-DCA was found in MW-106 and MW-107 at concentrations exceeding screening levels. The results will be further evaluated as part of a vapor intrusion evaluation. A vapor intrusion evaluation is presented as a common element among the remedial alternatives evaluated in the FS.

2.2.2.3 Feasibility Study

2010—FS by CH2M HILL. The FS developed and evaluated remedial alternatives that address potential unacceptable risks to human health and the environment identified in the RI, and meet applicable or relevant and appropriate requirements (ARARs). Remedial action objectives (RAOs) were established based on regulatory requirements, standards, and guidance. PRGs were developed based on regulatory requirements, standards, and guidance to meet the site-specific RAOs. General response actions were identified for the site to develop remedial alternatives. Based on the risks present at the site, the following alternatives were developed: Alternative 1, No Action; Alternative 2, In Situ Groundwater Treatment using Thermal Technologies, Soil and Powder Well Sediment Removal, and Offsite Disposal; Alternative 3, In Situ Groundwater Treatment and Soil and Powder Well Sediment Removal and Offsite Disposal; and Alternative 4, Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal, and Offsite Disposal. The alternatives were evaluated against seven feasibility evaluation criteria as defined in the NCP and CERCLA (CH2M HILL 2010).

2.2.3 Site Removal and Remedial Actions

No remedial actions at the St. Louis Ordnance Plant have occurred to date. However, decontamination efforts and demolition of buildings, bunkers, and magazines have been completed throughout the operational history of the site.

According to the 1991 *Environmental Study* by USATHAMA (1991), following deactivation of the St. Louis Ordnance Plant in 1945, buildings having explosives contamination were decontaminated by USACE. This was reportedly conducted in accordance with regulations of the Safety and Security Branch Office, Chief of Ordnance, Chicago. Although no records are available describing the procedures employed or the results obtained in the decontamination project, many of the buildings were marked with "XXX," signifying 99.9 percent clean. The mark was typically used to indicate decontamination and inspection following decontamination to verify safety and absence of explosives contamination. With the exception of the powder wells, magazines and buildings throughout the former Hanley Area were marked "XXX."

The U.S. Army required Hanley Industries, Inc., to conduct decontamination of buildings following lease termination in 1979. Decontamination procedures reportedly consisted of spray washing of the walls in the buildings to a height of 8 feet above the floor. None of the magazines were spray washed. Washdown wastewater from decontamination activities was discharged onto the ground surface outside the buildings (USATHAMA 1991).

According to the May 2005 USACE *Technical Memorandum – Final Hanley Area Phase I Remedial Investigation* (USACE 2005), Buildings 218A, 218B, and 218C were demolished by the 89th RRC in the summer of 2004. Building 219B was demolished in 2005.

The June 2007 USACE *Final Supplemental Soil and Groundwater Phase II Remedial Investigation Technical Memorandum* (USACE 2007) states that Building 220 was demolished in March 2007. According to the 2004 SCS Engineers *Building 220, Guard House, and Harboad Street Bridge Demolition and Site Restoration Report* (SCS 2007), 54 loads of clean fill were brought in to fill the void at former Building 220, and finish grading was completed to match the surrounding topography.

2.2.4 Summary of Enforcement Actions

No enforcement actions have been taken at the former Hanley Area to date.

2.3 Community Participation

In April 2004, the U.S. Army began community involvement efforts for environmental activities at the former Hanley Area, and the administrative record file was established at the St. Louis Central Public Library (the administrative record file was subsequently moved to the Julia Davis Branch Library in 2010). A notice announcing the availability of the file and points of contact for the USAEC and USACE–Kansas City District was published in the *St. Louis Post-Dispatch* and *St. Louis American* in January 2005.

In June 2006, nearby residents were mailed a letter informing them of the U.S. Army's investigation of potential groundwater contamination in the vicinity of the former Hanley Area. A second letter dated September 17, 2007, notified residents and property owners that the U.S. Army would be seeking access to some properties to collect environmental samples.

On March 28, 2008, the U.S. Army mailed questionnaires to seven community members. The affected community is defined as the five homes immediately across Stratford Avenue from the site and the first two homes along Goodfellow Boulevard immediately north of the site.

The U.S. Army has coordinated community involvement/input with the alderman who represents the neighborhood and Job Corps training center staff on an ongoing basis.

The notice of availability of the Proposed Plan and date of the public meeting was published on November 25, 2010, in *The St. Louis American* and on November 26, 2010, in the *St. Louis Post-Dispatch*. The public meeting was held on December 13, 2010, at the Julia Davis Branch Library in St. Louis, Missouri. Information regarding the site and the remedy was available at the public meeting, and representatives from the U.S. Army were present to answer questions from the public. MDNR distributed general environmental information for the State of Missouri. A transcript of the meeting is available in the Administrative Record. Responses to substantive comments received at the meeting and during the comment period are provided in the Responsiveness Summary in Section 3.

The Proposed Plan and other supporting site documents, including the RI, FS, and other investigation reports, are available in the administrative record file at Julia Davis Branch Library in St. Louis, Missouri.

2.4 Scope and Role of Response Action

The FS identified remedial alternatives and evaluated them to select a preferred remedy for the former Hanley Area. The selected remedy presented in this decision document will be the final response action for the former Hanley Area.

The response action addresses soil and groundwater impacted by releases of materials that occurred at the former Hanley Area. The releases have resulted in several localized areas of surface soil contamination across the former Hanley Area and plumes of

contaminated groundwater in the northern part of the site that have migrated offsite under Stratford Avenue.

Areas of surface soil contamination will be excavated and properly disposed of offsite to prevent future human exposures to these contaminants. Although powder well sediment was not evaluated in a human health risk assessment (HHRA) in the RI, it will be removed and disposed of offsite to prevent future human exposure to the material.

Potential construction worker exposures to groundwater will be addressed by a combination of in situ groundwater treatment using chemical processes and soil mixing, groundwater monitoring, and land use controls.

Potential future onsite exposures to potentially harmful vapors emanating from contaminated soil will be addressed through onsite LUCs. In addition, because of the uncertainty of future indoor air risk, a vapor intrusion evaluation will be performed as part of the site remedy. If the evaluation reveals that indoor vapor concentrations in offsite residences pose an unacceptable risk to the residents and are related to the former Hanley Area, appropriate response measures will be implemented by the U.S. Army. Such measures could include installation of a ventilation system to remove vapors from living areas within the residences or other effective action. Based on the uncertainty of future indoor air risk, the vapor intrusion pathway will be further evaluated as part of the site remedy.

Although not part of the response action, City of St. Louis Ordinance 66777 provides protection to future onsite residents and current offsite residents from groundwater as a potable water supply. On August 1, 2005, the City of St. Louis approved Ordinance 66777. The ordinance prohibits the use or attempted use of groundwater as a potable water supply and the drilling or installation of wells for a potable water supply within the corporate limits of the City of St. Louis. Further, the ordinance authorizes the Mayor of the City of St. Louis to enter into a Memorandum of Understanding (MOU) with MDNR. The MOU was signed on October 25, 2006. It specifies the City's and MDNR's responsibilities in satisfying the ordinance requirements. Under the MOU, the City's responsibilities include the following:

- The City will notify MDNR of proposed changes to Ordinance 66777 or requests for variance at least 30 days before the date that the local government is scheduled to take action on the proposed change or request.
- The City will enforce the ordinance and notify MDNR when the ordinance is violated.

The City will allow MDNR access to information necessary to monitor adherence to the terms of the MOU or the ordinance. In the unlikely event that the City Ordinance 66777 is repealed, the U.S. Army and MDNR will evaluate alternative measures to protect current and future residents from consuming groundwater as a potable drinking water source.

2.5 Site Characteristics

The former Hanley Area is 14.68 acres in size and consists of a relatively flat terrace, which slopes steeply down to Goodfellow Boulevard to the east and Stratford Avenue on the north. There is evidence of grading, with high points cut and low areas filled to generally level the

site. Based on survey data collected at the site, the elevations of the site range from 532 to more than 558 feet above mean sea level. An elevation change (greater than 18 feet) occurs between the northern portion of the site and Stratford Avenue. Current site features are shown in Figure 2-2.

As discussed in Section 2.2.1, most of the former buildings and bunkers at the former Hanley Area have been demolished, with the exception of Buildings 219A, 219D, 219G, and 236. According to the 88th RSC, Buildings 219A, 219D, and 236 are used for storage only. Building 219G is occupied during business hours, and the site is completely fenced (partially with iron fencing, the balance with a 6-foot-tall chain-link fence).

The site contains former powder wells, underground rooms (former basements and bunkers), tunnels for service utilities, and a combined underground wastewater and stormwater collection system. The underground structures are still intact. The tunnels are located 10 to 12 feet below ground (USATHAMA 1991).

2.5.1 Geology and Hydrogeology

Overburden soils at the former Hanley Area consist primarily of lean clay. The soil lithology is relatively consistent across the site. Residuum exists from the ground surface up to 25 feet below ground. Residuum is derived from complete weathering of the parent bedrock, in this case, shale. Fill material including gravel, concrete rubble, brick debris, and sand, were also observed in the northern portion of the site as deep as 11 feet, likely the result of demolition of former Building 220, backfilling, and grading activities. Figure 2-3 shows the location of the geologic cross section depicted in Figure 2-4.

Discontinuous lenses of silt are present within the native lean clay. A fat clay layer with discontinuous lenses of lean clay exists beneath the lean clay, decreasing in thickness offsite to the north until pinching out near monitoring well MW-108 (Figure 2-4). Weathered shale with discontinuous lenses of silt and clay underlies the clay. The discontinuous lenses of silt and clay within the weathered shale are likely the result of differential weathering along bedding planes. The thickness of the weathered shale ranges from 6 to 12 feet in boreholes advanced to depths at which the competent bedrock was encountered (monitoring wells MW-116 and MW-117). Competent shale was encountered at monitoring well MW-116 at 34.0 feet below ground and at monitoring well MW-117 at 38.3 feet below ground. When the soil boring at monitoring well MW-117 was advanced, a coal layer roughly 6 inches thick was observed at 45 feet below ground.

Groundwater is present within more permeable silt and clay lenses that are locally discontinuous within the upper lean clay unit.

Saturated conditions were not observed within the weathered shale underlying the clay unit. Groundwater was encountered in a 6-inch saturated coal layer within the competent shale zone. Groundwater within the coal does not appear to be hydraulically connected to groundwater observed in the discontinuous silt and clay lenses. In June 2008, the groundwater level measured in MW-117, screened within competent shale, was roughly 8.5 feet lower than the groundwater level measured in MW-111, located 4 feet west of MW-117 and screened in the overburden clay.

As shown in Figure 2-5, groundwater generally flows from the south and west to the northeast. The depth to groundwater within the lean clay is less than 1 foot below ground at monitoring well MW-110 to more than 24 feet below ground upgradient of former Building 220.

2.5.2 Risk-Based Screening Levels

The first step in the nature and extent evaluation was to select conservative risk-based screening levels for the chemicals detected at the former Hanley Area. Screening levels are used both to identify chemicals that might pose a risk to human health or the environment and to provide concentrations to guide the delineation of the extent of contamination. The screening levels were developed for preliminary human health risk evaluations. The ecological risk assessment evaluated risk to the environment. The human health screening levels are based on the residential scenario. The risk-based screening levels used for this site are summarized below, and additional information on the screening levels is provided in the RI report (CH2M HILL 2009).

2.5.2.1 Soil

Soil screening levels were derived from the following sources:

- USEPA Region 6 medium-specific screening levels (MSSLs) for residential and industrial land use. MSSLs based on noncarcinogenic effects were adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ. The selection of residential or industrial land use MSSLs was based on sample depth, as described below.

- USEPA soil screening levels (SSLs) for protection of migration to groundwater using a dilution-attenuation factor (DAF) of 20. The DAF of 20 was selected as appropriate for the site based on the clay soil present, which results in a low hydraulic conductivity and slow infiltration rate. Other factors influencing the use of DAF 20 as appropriate are the thickness of the unsaturated zone (about 15 feet) and the size of the contaminant source areas (less than 30 acres) (USEPA 1996).

- Soil background values established during the Environmental Baseline Survey for the adjacent former St. Louis Army Ammunition Plant (SLAAP). The background study included the collection of 10 surface (0 to 0.5 foot below ground) soil samples at 2 municipal parks to establish regional background concentrations for metals and PAHs in the vicinity of SLAAP. Five surface soil samples were collected from Penrose Park, just south of I-70 on both sides of North Kingshighway Boulevard, 1.3 miles southeast of SLAAP. Five surface soil samples were collected from Dwight Davis Park, located north of I-70 and east of Riverview Boulevard between Lillian and Theodore avenues, 0.4 mile east-northeast of SLAAP. During their review of the RI report, MDNR and USEPA expressed concerns over using SLAAP background concentrations as screening levels for the former Hanley Area. The concerns focused primarily on PAHs because the SLAAP background PAH levels exceeded PAH concentrations measured at the former Hanley Area. As discussed in Section 2.7.1.1, the use of the SLAAP background concentrations did not affect HHRA findings or RI conclusions.

From the sources cited above, screening levels were assigned as follows:

Soil between 0 and 10 feet below ground. The screening levels are the lower of (1) the USEPA MSSLs for residential land use (adjusted downward by a factor of 10 if based on noncarcinogenic effects) and (2) the USEPA SSLs for protection of migration to groundwater using a DAF of 20. Soil background values established for SLAAP were used in place of the MSSL or SSL when the background value was higher.

Soil greater than 10 feet below ground (to the depth of the site sewer lines). The screening levels were USEPA Region 6 MSSLs for industrial soil, since only utility workers may contact soil at this depth. Per the RI work plan (CH2M HILL 2008), the screening levels were to be used to discuss the nature and extent of site contaminants and to provide preliminary human health risk evaluations. However, during the August 27, 2008, meeting MDNR, USEPA Region 7, USACE, 89th RRC, MDHSS, and CH2M HILL agreed that utility worker exposure to deep soil (greater than 10 feet below ground) did not need to be quantified in the HHRA because of the infrequency of exposure (CH2M HILL 2009).

2.5.2.2 Groundwater

Groundwater screening levels are the lower of (1) the USEPA Region 6 MSSLs for tap water (adjusted downward for noncarcinogens by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ), and (2) the USEPA screening level for protection of indoor air based on a target risk of 1×10^{-6} (USEPA 2002). The screening levels provide a conservative evaluation of the potential risks associated with chemicals in groundwater. The screening levels are conservative because groundwater at the site is not used for potable purposes, and offsite residents do not use groundwater as a potable water supply. Effective August 1, 2005, St. Louis City Ordinance 66777 prohibits the installation of potable water supply wells.

2.5.2.3 Indoor Air

Indoor air and ambient air results are compared to USEPA Region 6 MSSLs for ambient air. The screening levels provide a conservative evaluation of the potential risks associated with chemicals in indoor air, particularly for TCE. As a result of a discussion between the U.S. Army, MDNR, and USEPA Region 7 held on April 22, 2008, the screening level for TCE has been established at 1 microgram per cubic meter (CH2M HILL 2008).

2.5.3 Nature and Extent of Site Contaminants

Previous investigations performed at the former Hanley Area have sufficiently delineated the nature and extent of chemicals above screening levels for the purpose of developing a site remedy. The RI report (CH2M HILL 2009) presents a comprehensive understanding of site conditions and potential risk associated with site contaminants. The nature and extent of contamination is summarized in the following subsections.

2.5.3.1 Surface Soil

Contamination in surface soil (0 to 2 feet below ground) consists of metals, VOCs, PCBs, and PAHs. Surface soil analytical results from previous investigations are presented in Tables 2-1 through 2-14.

Metals

The following metals exceeded screening levels in one or more surface samples from the former Hanley Area:

- Aluminum
- Antimony
- Arsenic
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Selenium
- Silver
- Thallium
- Vanadium

As discussed in the RI report, aluminum, iron, manganese, and vanadium were determined to be naturally occurring and not attributable to site activities (CH2M HILL 2009). The conclusion is based on the relatively uniform distribution of the metals across the site (and offsite) and their concentrations falling within the range of published metal concentrations in Missouri soil (Tidball 1984).

Figure 2-6 presents the concentrations of the remaining metals (antimony, arsenic, chromium, copper, lead, selenium, silver, and thallium) that exceed their screening levels. The metals were delineated during previous investigations, with the exception of arsenic at the western property boundary adjoining Job Corps property. To fill that data gap, the U.S. Department of Labor collected six soil samples on the property in the area adjoining the elevated arsenic concentrations. On September 28, 2009, USEPA collected two split surface soil samples and analyzed them for metals. Arsenic concentrations of 7.4 and 7.2 mg/kg were measured in these samples.

The metals described in the RI as exceeding their respective screening levels and the locations of the exceedances are listed below.

Antimony. Antimony concentrations observed above the screening level at the former Hanley Area occur at the following locations:

- Within the bunker walls at Building 219B
- Uutside the east bunker wall at Building 219J
- Outside the south bunker wall at Building 227B
- Near Building 227O, outside the south bunker wall at Building 228B
- Outside the north bunker wall at Building 228M

Arsenic. Arsenic concentrations observed above the screening level at the former Hanley Area occur at the following locations:

- West of the bunker wall at Building 219C
- Near and within the east bunker wall at Building 219C
- Within the bunker walls at Building 219B
- Near the north bunker walls at Buildings 227O and 228E
- Near the south bunker walls at Buildings 228A, 228B, and 228C
- Surrounding the north, south, and west sides of Building 236

The source of arsenic found in surface soil around the Building 219 bunker series is potentially attributed to previous site activities. Buildings 219E and 219F housed Hanley's lead azide reactor, and Buildings 219B, 219C, and 219J were used for open-air drying of explosives. During initial operations between 1941 and 1945, blended pyrotechnic chemicals were

transferred to the Building 228 bunker series for final drying operations. Upon completion of the drying, the finished primers were moved to the Building 227 series for temporary storage.

Chromium. Elevated chromium was isolated to one location near Building 227M.

Copper. Copper concentrations exceeding the screening level in surface soil appear confined to the north and west sides of Building 218A. The elevated copper concentrations are bounded laterally to the east and south.

Lead. Lead concentrations exceeding the screening level in surface soil occur at the following locations:

- South of Building 228Z along the southern site boundary of the former Hanley Area
- Within the confines of the bunker walls at Building 219F
- North of Building 218A, where subsequent composite sampling showed the lead in this area was of limited areal extent
- Within the confines of the bunker walls at Building 219 F, where subsequent samples showed the lead in this area was of limited areal extent
- North of Building 219 G, which was bound by samples to the south and east
- West of Building 218C, where subsequent samples showed the lead in this area was of limited areal extent
- East of Building 219J, where subsequent samples showed the lead in this area was of limited areal extent

The former source of lead in surface soil south of Building 228Z along the southern site boundary, north of Building 218A, within the confines of the bunker walls at Building 219F, near Building 220, north of Building 219G, west of Building 218C, east of Building 219J, and south of Building 228B is likely related to primer material containing lead azide that was used during previous site activities.

An elevated lead concentration was detected at historic soil boring SB-020 (near former Building 220 located on the north part of the site) in 2005. During the field investigation, effort was made to place surface soil sample boring HA-22 as close as possible to previous soil boring SB-020. According to the 2004 SCS Engineers *Building 220, Guard House, and Harboad Street Bridge Demolition and Site Restoration Report* (SCS 2007), 54 loads of clean fill were brought in to fill the void at former Building 220, and grading was completed to match the surrounding topography. Since SB-020 was collected immediately adjacent to the east wall of former Building 220, and, based on several pictures included in the Demolition and Site Restoration Report (SCS 2007), extensive reworking and regrading of the area is evident. The lead concentration was likely dispersed below the screening level, as observed in the surface soil sample collected during the RI at HA-22.

Selenium. Selenium concentrations that exceed the screening level in surface soil were observed south of Building 220 and downgradient to the northeast of Building 220, where subsequent samples showed the selenium concentration was of limited areal extent. Selenium concentrations in excess of the screening level in surface soil were observed south of Buildings 228Y and 228Z. The elevated selenium concentrations are bounded laterally by samples with concentrations below the screening level near the southern site boundary.

Silver. Elevated silver was isolated to one location within the bunker walls of Building 219E.

Thallium. Thallium concentrations in excess of the screening level occur at the following locations:

- North, east, and west of Building 218A
- East of Building 218B
- East and south of Building 218C
- West and northeast of Building 220
- Within the bunker walls surrounding Buildings 219C, E, and H

Thallium exceeded the screening level in 13 samples, but it exceeded the unadjusted MSSL of 5.5 mg/kg at only three locations (SS-218-A-1, SS-218A-3, and SS-218B-2 in 2001). The highest thallium concentration was measured at SS-218A-1, at an estimated concentration of 8.64 mg/kg.

Volatile Organic Compounds

PCE and TCE exceeded screening levels in 3 of 11 surface soil samples in the northern part of the former Hanley Area, downgradient from the former Building 220 in 2007. VOCs exceeding screening levels are shown in Figure 2-7. PCE exceeded the screening level in SB-024, SB-027, and SB-028, with the highest PCE concentration at SB-028 (6,400 micrograms per kilogram [µg/kg]) observed in 2007. TCE exceeded the screening level in one sample (SB-028) observed in 2007.

Polycyclic Aromatic Hydrocarbons

The following PAHs exceeded screening levels in one or more samples collected from the former Hanley Area:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h)anthracene
- Fluoranthene
- Indeno(1,2,3-cd)pyrene
- Pyrene

These PAHs exceeded screening levels in SB-020 (Figure 2-8) observed in 2005. Benzo(b)fluoranthene exceeded the screening level in SB-010 and CSS-009. During the 2008 field investigation, one surface soil sample (HA-22) was collected to assess PAH concentrations near SB-020. PAH concentrations in HA-22 fell below screening levels, suggesting that soil in the area was reworked after the original sample was collected in 2005, indicating that the elevated PAH concentrations in the area are isolated in occurrence. The former source of PAHs in surface soil east of former Building 220 located on the north part of the site is not known, but may be related to the proximity to the asphalt drive.

Polychlorinated Biphenyls

The PCB Aroclor 1260 exceeded its screening level (Figure 2-8), which corresponds to the Toxic Substances Control Act-defined acceptable level of 1 mg/kg. The exceeding concentrations are limited to an area near the southern boundary of the former Hanley Area. The contamination is associated with an historical release from a former transformer located near former Building 228C. Though the extent of the PCB impact is not defined laterally, the low mobility of PCBs suggests that the vertical extent is limited to roughly the upper 2 feet below ground.

2.5.3.2 Subsurface Soil

Subsurface soil samples (more than 2 feet below ground) have been collected during investigations performed in 1998, 2001, 2005, 2007, and 2008. Analytical results from subsurface soil samples are provided in Tables 2-5, Tables 2-7 through 2-12, and Table 2-15. Various metals and VOCs were measured at concentrations above screening levels in subsurface soil beneath the former Hanley Area. The metals in the subsurface were determined to be naturally occurring, and so no further action is needed to address them. Subsurface VOC contamination in saturated soil is present around former Building 220 in the northern part of the site (Figure 2-9). VOC contaminant mass near former Building 220 is likely related to the migration of the constituents in groundwater. Dense nonaqueous phase liquid (DNAPL) was not observed during previous investigations. However, PCE observed in soil at the 2007 soil boring SB-023 (3,200,000 µg/kg) at 25 to 26 feet below ground (Figure 2-9) could indicate the presence of DNAPL above the weathered shale.

2.5.3.3 Groundwater

Metals

Groundwater samples were collected from monitoring wells MW-101 through MW-105 in 2001 and MW-101 through MW-106 in 2005 and 2007. Table 2-16 presents metal concentrations measured in the groundwater samples. Concentrations of aluminum, arsenic, cadmium, iron, lead, manganese, thallium, and vanadium in groundwater exceeded screening levels in one or more samples collected in 2001, 2005, and 2006. Aluminum, iron, manganese, and vanadium concentrations in soil are comparable to naturally occurring concentrations in Missouri soils (Tidball 1984). The presence of the metals in groundwater is likely naturally occurring in the subsurface.

Arsenic. Arsenic was detected slightly above the screening level at monitoring wells MW-101 and MW-103 in 2006. Monitoring well MW-101 is located more than 320 feet south (upgradient) of the southern site boundary of the former Hanley Area. Arsenic at monitoring well MW-101 does not appear to be related to surface soil contamination observed at the former Hanley Area, as groundwater flow is to the north and northeast. The arsenic concentration observed at upgradient monitoring well MW-101 is higher than the concentration observed at monitoring well MW-103. Therefore, it is not likely that arsenic in the groundwater at monitoring well MW-103 is related to previous site activities.

Cadmium. Cadmium was detected slightly above the screening level at monitoring well MW-104 in 2006, but it was not detected in this well in 2001 or 2005. The source of cadmium is unknown, as results of previous investigations at the former Hanley Area did not indicate cadmium in soil at concentrations above the screening level. Cadmium was included as part of the SLAAP background study (URS 2004), and results from the study indicate that cadmium concentrations in soil observed at the site are representative of background. Cadmium in soil likely contributes to the elevated concentration observed in groundwater at monitoring well MW-104.

Lead. Lead was detected slightly above the screening level at monitoring well MW-106 in 2006. Lead in soil may contribute to the elevated groundwater concentration observed at monitoring well MW-106. The nearby surface soil sample SB-020 registered a lead concentration of 983.3 mg/kg in 2005.

Thallium. Thallium was detected above the screening level at monitoring wells MW-101, MW-103, and MW-106 in 2006. Thallium was not detected in those wells during previous groundwater monitoring events. Thallium was found at its highest concentration in monitoring well MW-101, more than 320 feet south (upgradient) of the southern site boundary of the former Hanley Area. Because of its upgradient location, thallium in monitoring well MW-101 is not related to onsite surface soil concentrations of thallium. The onsite thallium concentrations measured in monitoring wells MW-103 and MW-106 are not near areas where thallium was found in surface soil at concentrations above the screening level. Thallium in groundwater at monitoring wells MW-103 and MW-106 is not likely related to previous site activities.

Volatile Organic Compounds

Groundwater samples from the former Hanley Area were collected from monitoring wells and analyzed for VOCs as described below:

- In 2005 and 2006, a groundwater sample was collected from MW-106.
- In 2007, groundwater samples were collected from MW-106 through MW-114.
- In 2008, groundwater samples were collected from MW-106 through MW-117.
- In 2010, groundwater samples were collected from MW-106 through MW-118.

Results from the sampling efforts revealed dissolved-phase groundwater contamination in the northern portion of the former Hanley area. The contamination consists of three distinct plumes comprising one or more of cVOCs. In addition, other VOCs were detected at concentrations above screening levels in isolated occurrences within and around the plumes. The results are presented in Table 2-17 and depicted in Figure 2-10.

Plume A. PCE, TCE, and *cis*-1,2-DCE make up Plume A. The sewer system downgradient and northeast of former Building 220 is suspected to be the primary source of Plume A. The presence of TCE and *cis*-1,2-DCE may be attributed to reductive dechlorination of PCE. There is no historical record of a single large spill, but sporadic discharge of small quantities of spent product is assumed to have occurred. Figure 2-10 illustrates the extent of the PCE and TCE at concentrations above the USEPA MCL of 5 micrograms per liter (µg/L) and *cis*-1,2-DCE above the MCL of 70 µg/L. The MCLs were used as the screening levels for contaminants in groundwater. The depth of contamination is just below ground to the weathered shale interface at roughly 26 to 28 feet below ground. During the RI, groundwater levels within Plume A ranged from 0.20 foot below ground at MW-110 to 4.76 feet below ground at monitoring well MW-109.

Remediation Evaluation Model for Chlorinated Solvents (REMChlor) Version 1.0[1] was used to model the fate and transport of TCE at Plume A. TCE in groundwater was modeled because TCE has a higher water solubility level than PCE. The model was developed by Clemson University's Departments of Geological Sciences and Environmental Engineering and reviewed by USEPA and the Center for Subsurface Modeling Support. REMChlor was selected because of its ability to predict remediation effectiveness for the former Hanley Area. Use of the model for prediction of absolute plume length dynamics over time is beyond the scope of this effort.

[1] http://www.epa.gov/ada/csmos/models/remchlor.html

Based on the REMChlor model predictions of a 1959 release, the leading edge of Plume A is either already near its maximum extent or will be within the next 5 years, if left untreated. The model output suggests that the TCE plume may migrate towards Stratford Avenue for another 3 years (until year 52, which is 2011) before the plume will begin to shrink because of destructive and/or nondestructive fate and transport processes. At year 52, the TCE will have migrated about 148 feet from monitoring well MW-111 (the assumed original source area used for modeling purposes).

To assess the uncertainty of when the release(s) occurred, a spill release date of 1941 and a release date of 1979 were also modeled using REMChlor in addition to the 1959 release date. The 1941 release scenario indicates that the plume footprint is possibly decreasing. The 1979 scenario suggests that the plume will continue to migrate for 70 years after the calibration year of 2008 before it begins to shrink. At its maximum extent in 2078, the plume will have migrated 279 feet, which is an additional 131 feet downgradient from the 2008 leading edge of the plume.

Plume B. Plume B, consisting of 1,2-DCA, is largely commingled with Plume A. The source of 1,2-DCA in soil and groundwater is likely attributable to laboratory and maintenance shop activities conducted at former Building 220. 1,2-DCA was used as a solvent in the industrial industry and as a constituent in scouring compounds (Agency for Toxic Substances and Disease Registry 2005). Spent product likely was discharged into the sewer inlets on the west and east sides of the concrete loading slab at the northeast corner of former Building 220. Based on the location of the 1,2-DCA in groundwater, leaks in the sewer system may have contributed to the vertical and lateral migration of the contaminant, but they have not been clearly identified as the potential point of release. There is no known continuing source of 1,2-DCA. Figure 2-10 illustrates the extent of Plume B at concentrations above 5 µg/L, the MCL as measured during the 2008 RI. The depth of contamination is just below ground to the weathered shale interface at roughly 24 to 30 feet below ground. During the RI, groundwater levels within Plume B ranged from 0.20 foot below ground at MW-110 to 10.31 feet below ground at monitoring well MW-106.

During the 2010 predesign groundwater investigation, 1,2-DCA was found in MW-106 and MW-107 at concentrations exceeding screening levels. The exceeding concentration in MW-107 falls outside of the Plume B footprint shown in Figure 2-10. The U.S. Army will further assess groundwater conditions in this area north of the site during an upcoming vapor intrusion evaluation that is discussed in Section 2.12.2.3.

As noted in the RI, modeling was not conducted for the 1,2-DCA plume because a contaminant source was not evident based on available information.

Plume C. Plume C, southwest of former Building 220, consists of commingled CT, chloroform, and TCE. The source of Plume C is unknown. CT and TCE appear to be the original constituents of the plume, with chloroform present as a breakdown product of carbon tetrachloride. The extent of the plume is small and has been delineated in the downgradient direction. Figure 2-10 illustrates the extent of the CT and TCE at concentrations above 5 µg/L, the MCL for drinking water. The depth of contamination is more than 10 feet below ground to the weathered shale interface at roughly 34 feet below ground. During the 2010 groundwater predesign investigation, groundwater was encountered at a depth greater than 23 feet below ground at monitoring well MW-118.

Modeling was not conducted for the CT plume because of the small and isolated plume footprint; however, some migration would be expected. The CT plume is bounded by sampling locations where CT was not detected, suggesting that the CT is relatively immobile and may be entrapped within finer-grained subsurface materials. Another possible explanation for the limited extent of CT is that it was released more recently than the contaminants observed in Plumes A and B. CT is comingled with TCE in Plume C. The TCE does not appear to have degraded anaerobically, as indicated by the lack of daughter products such as *cis*-1,2-DCE.

2.5.3.4 Vapor Intrusion

A vapor intrusion investigation and indoor air investigation were conducted in March 2008, in the residential area north of the site, across Stratford Avenue, to assess potential vapor intrusion associated with subsurface groundwater contamination, specifically, PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-dichloroethene, vinyl chloride, and 1,2-DCA. The scope of work included soil gas sampling, indoor and ambient air sampling, and groundwater sampling.

After several attempts to collect soil gas samples near the residences north of the site and subsequent discussions with USACE and MDNR on March 21, 2008, it was determined that soil gas samples could not be collected because of tight expansive clays. Therefore, only indoor air and ambient air samples and groundwater samples were collected during the March 2008 investigation.

One indoor air sample, collected in March 2008, contained TCE above the low end of the acceptable risk level. Based on that result, an additional round of air samples was collected in May 2008. Results from the May 2008 samples indicated no immediate unacceptable risks to residents. Further assessment of the vapor intrusion pathway will be made during a vapor intrusion evaluation discussed in Section 2.12.2.3. Indoor air sampling results are shown in Table 2-18.

2.5.3.5 Powder Well Sediment

In 2001, 22 powder wells were located across the former Hanley Area. Eighteen of the wells contained sediment with various metal concentrations exceeding conservative risk-based screening levels defined in the RI Report (CH2M HILL 2009). Explosives in powder well samples were not detected at concentrations above the screening levels.

The sediment within the powder wells, though characterized, was not evaluated in the HHRA because it will be removed as part of a remedial action. The powder well locations are shown in Figure 1-2, and analytical results are provided in Table 2-19.

2.5.4 Conceptual Site Model

A conceptual site model for the former Hanley Area is shown in Figure 2-11. The following pathways for current and future receptors were considered in developing the conceptual site model and in preparing the HHRA. Reasonable exposure scenarios were developed based on how the former Hanley Area is currently used and assumptions about its future use.

- Under current site use, onsite indoor industrial workers and offsite residents (on the Job Corps property) could be exposed to chemicals in surface soil (0 to 2 feet below ground)

through incidental ingestion, inhalation of volatile emissions and dust in ambient air, and dermal contact with soil and dust.

- Under current site use, onsite industrial workers and offsite residents (along Stratford Avenue) could be exposed to chemicals through inhalation of volatile emissions that have migrated into indoor air by vapor intrusion.
- In the future, trespassers may gain access to the site if the fence is not maintained and the site is not developed. Trespassers could be exposed to chemicals in surface soil through incidental ingestion, inhalation of volatile emissions and dust in ambient air, and dermal contact with soil and dust.
- Under future residential land use, onsite residents could be exposed to chemicals through inhalation of volatile emissions that have migrated into indoor air by vapor intrusion.
- In the future, construction workers might excavate soil (0 to 10 feet below ground) for utility installation, maintenance activities, basement construction, or other purposes, bringing them into contact with chemicals in soil. Construction worker exposures to chemicals in soil could occur through incidental ingestion, inhalation of volatile emissions and dust in ambient air, and dermal contact pathways.
- Under a future residential land use scenario, onsite and offsite residents (on the Job Corps property) could be exposed to chemicals in soil from 0 to 10 feet below ground that is brought to the surface during site redevelopment. Potential exposure could occur through incidental ingestion, inhalation of volatile emissions and dust in ambient air, and dermal contact with soil/dust.
- Under current and future land use, hypothetical potable use of groundwater was evaluated at the request of MDNR and MDHSS even though the current and future exposure pathways for potable groundwater are incomplete (due to City Ordinance 66777). The hypothetical exposure scenarios for onsite and offsite residential use of potable groundwater are ingestion, dermal, and inhalation exposures to chemicals in bathroom air from volatilization of tap water during showering.
- Under future land use, construction workers excavating soil immediately downgradient of former Building 220 may encounter groundwater that has seeped into the excavation and chemicals could volatilize directly from groundwater into ambient air within the excavation. Potential exposure scenarios could occur through dermal contact with groundwater and inhalation of VOCs in ambient air from groundwater in excavations.
- In the future, construction workers may encounter offsite groundwater along Stratford Avenue. Potential exposure scenarios are dermal contact with groundwater and inhalation of VOCs in ambient air from groundwater in excavations.
- Sewer lines are present about 20 feet below ground in some areas of the site. Maintenance or repairs have not been needed for more than 30 years, but under future land use, utility workers may need to repair the lines from time to time. Future maintenance or repairs would be conducted over a few days' duration only.

2.6 Current and Potential Future Site and Resource Uses

The former Hanley Area consists of 14.68 acres and is used for industrial purposes. Onsite buildings and bunkers have been demolished, with the exception of Buildings 219A, 219D, 219G, and 236. According to the 88th RSC, only Building 219G is occupied. Buildings 236, 219A, and 219D are used for storage only. Building 219G is occupied during business hours and the site is completely fenced in (partially with iron fencing and the remaining with a 6-foot-tall chain-link fence).

The site is bordered by the Job Corps facility on the west and residential areas to the north, west, and southwest. The area to the east was formerly part of the St. Louis Ordnance Plant and is now owned by the General Service Administration. The 89th RRC owned the former Hanley Area until the 89th RRC was disestablished in June 2009. The 88th RSC now owns the site and occupies the Sverdrup U.S. Army Reserve Center south of the site. According to the City of St. Louis Zoning Department and Assessor's Office, the St. Louis Ordnance Plant encompasses 125 acres and includes the Job Corps property to the west of the former Hanley Area and Plant No. 2, and the property east of Goodfellow Boulevard (Plant No. 1). The entire site, as described by the Zoning Department, is zoned industrial, commercial, and residential.

In 2005, the St. Louis Planning Commission adopted a strategic land use plan for the City of St. Louis. The plan provides a roadmap for future development. It identifies established neighborhoods, historic districts, and business areas that the City intends to maintain and enhance. It also identifies areas where future development and land use changes are encouraged. The St. Louis Strategic Land Use Plan identifies the former Hanley Area as a "business and industrial development area." Neighboring parcels to the south and east are similarly designated. Residential properties to the north of the former Hanley Area, across Stratford Avenue, are designated as a "neighborhood preservation area." Parcels north of the former Hanley Area that lie along Goodfellow Boulevard are designated as a "neighborhood commercial area" (St. Louis Planning and Urban Design Agency 2009). Although the General Services Administration and 88th RSC do not have immediate plans for developing the property, the City of St. Louis has expressed interest in obtaining and redeveloping the former Hanley Area in the future.

City-supplied drinking water is provided to residents and industries in the area. The city draws water from the Mississippi River from intakes upstream of the site. At its closest point, the Mississippi River is located about 3 miles from the site.

2.7 Summary of Site Risks

2.7.1 Summary of Human Health Risk Assessment

The U.S. Army completed a HHRA during the RI for the former Hanley Area (CH2M HILL 2009). The HHRA estimated the risks that contamination could pose to human health and the environment. The risk assessment also identified the contaminants and exposure pathways that need to be addressed by the remedial action.

Some samples available for the site were not used in the HHRA since it had already been agreed by MDNR and USEPA that the locations where the samples were collected will be

addressed through a removal action. During a teleconference on September 2, 2008, representatives from MDNR, MDHSS, USEPA, and USACE agreed that certain areas of soil with elevated arsenic and lead concentrations would be excavated and therefore excluded from the HHRA. Those areas will be addressed through a soil removal action during remedy implementation. The surface soil samples and chemicals identified for removal are:

- Sample NS03A arsenic at 44 mg/kg; lead at 5,840 mg/kg
- Sample NS08A arsenic at 67.7 mg/kg
- Sample SS-218A-2 lead at 2,724 mg/kg
- Sample SS-219B arsenic at 108 mg/kg
- Sample SS-219C arsenic at 68.8 mg/kg

As with arsenic and lead, PCBs were excluded from the HHRA because the upcoming soil removal action will address the concentrations below.

- Sample SS-001 Aroclor 1260 at 1.44 mg/kg
- Sample SED-001 Aroclor 1260 at 569 mg/kg
- Sample SS55A Aroclor 1260 at 18,200 mg/kg

The powder wells, though adequately characterized, were evaluated in the RI. However, the powder wells were not evaluated in the HHRA because the sediment will be removed and the wells backfilled as part of a remedial action.

2.7.1.1 Selection of Chemicals of Potential Concern

Chemicals of potential concern (COPCs) are chemicals that may provide significant contributions to potential overall site risks and are potentially associated with site contamination. To identify COPCs, data from the former Hanley Area were grouped into exposure units. COPCs were identified by comparing the maximum concentration of each chemical in each exposure unit (described later in this section) against the corresponding screening level presented in the RI report (CH2M HILL 2009). Chemicals in each exposure unit with at least one concentration above the screening level were identified as COPCs.

It is noted that the RI work plan (CH2M HILL 2008) called for COPC screening in the HHRA without eliminating chemicals within background concentrations, followed by an evaluation of the risk attributable to background. The RI report followed a different sequence, performing the initial risk screening and eliminating chemicals within background levels, and then calculating the additional risk associated with chemicals within background concentrations. Although the sequence of the HHRA was performed out of order from that presented in the RI work plan, the HHRA conclusions presented in the RI report and summarized in Section 2.7.1.5 are unaffected by the sequence that was followed, because the risk attributable to the site and the risk attributable to background are the same under each sequence.

The COPCs for each exposure unit and their summary statistics (range of detected concentrations and frequency of detection) are presented in the RI report (CH2M HILL 2009). Exposure units are defined below.

Soil

To identify soil COPCs and assess potential risk, the site was divided into the following soil exposure units:

- **Onsite Surface Soil (Sitewide)—**Surface soil samples (collected from 0 to 2 feet below ground) were used for the evaluation of a current industrial worker scenario.
- **Onsite Subsurface Soil (Sitewide)—**Subsurface soil samples (collected from 0 to 10 feet below ground) were used for the evaluation of a future construction worker scenario.
- **Onsite Subsurface Soil (Exposure Units A through L)—**To evaluate residential exposure to onsite subsurface soil, the HHRA calculated risk estimates for 12 hypothetical exposure units (A through L), each roughly the size of a 1-acre residential lot, to address concerns regarding exposure concentration dilution. Figure 2-12 depicts the exposure units. For HHRA purposes, soil from the 0- to-10-foot depth range was evaluated for potential residential exposure, since in the future, soil greater than 2 feet in depth could be brought to the surface during redevelopment.

Groundwater

The site was divided into the following four groundwater exposure units:

- **Onsite Groundwater (Area Downgradient of Former Building 220)**
  - **Tap water and Indoor Air—**Onsite and offsite groundwater samples in the area downgradient of former Building 220 were used for the evaluation of a future residential scenario assuming hypothetical potable use of groundwater and vapor intrusion into indoor air.
  - **Groundwater in Excavations—**Onsite groundwater samples in the area downgradient of former Building 220 were used in evaluating a future construction worker scenario assuming that shallow groundwater seeps into an excavation where workers are present.
- **Onsite Groundwater (Sitewide Excluding Area Downgradient of Former Building 220)—**Onsite groundwater samples collected sitewide (excluding the area downgradient of former Building 220) were used to evaluate a future residential scenario (hypothetical potable groundwater use).
- **Onsite Groundwater (Within 100 feet of Building 219G)—**Onsite groundwater samples collected within 100 feet of Building 219G were used to evaluate the potential current indoor air pathway for industrial workers. One groundwater sample collected from MW-104 in 2006 was used. No volatile chemicals were detected in the groundwater sample, so the indoor air pathway for current industrial workers (who are only present at Building 219G) is not a concern.
- **Offsite Groundwater—**Offsite groundwater samples were used in evaluating future residential (hypothetical potable groundwater use) and construction worker (groundwater in an excavation) scenarios.

Indoor Air

A vapor intrusion evaluation was conducted in the residential area immediately downgradient of the site. The vapor intrusion evaluation was planned, implemented, and interpreted with continuous input from USEPA and endorsed by MDNR and DHSS. Indoor air samples were collected from the basement of the vacant residence at 6317 Stratford Avenue (immediately downgradient of the site groundwater plume) and used to evaluate the offsite residential scenario. Indoor air samples were collected during two sampling events in March and May 2008 (four samples total), and analyzed for VOCs. Two ambient (outdoor) air samples were collected at the porch of the residence in March and May 2008 to evaluate whether measured indoor air concentrations were a result of vapor intrusion or due to outdoor air levels.

2.7.1.2 Exposure Assessment

The object of the exposure assessment was to estimate the type and magnitude of exposures to the COPCs present at or migrating from the site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks.

The exposure assessment process has three steps:

1. Characterize the exposure setting.
2. Identify potential exposure pathways.
3. Quantify potential exposures.

Each of the steps is documented in Section 7.3, Exposure Assessment, of the RI report (CH2M HILL 2009).

Potential exposure pathways and receptors are summarized in the conceptual site model presented in Figure 2-11 and discussed in Section 2.5.4. Each of the exposure pathways presented in Section 2.5.4 were quantitatively addressed in the HHRA, with the following exceptions:

- **Soil and Groundwater Exposures in Deep Excavations—**Sewer lines are present about 20 feet below ground in some areas of the site. Maintenance or repairs have not been needed for more than 30 years, but utility workers may need to repair the lines from time to time. Future maintenance or repairs would be conducted over a few days' duration only, so exposures are not expected to be significant and were not quantified.

- **Indoor Air Exposures Downgradient of Former Building 220—**In the area downgradient of former Building 220, vapor intrusion from shallow groundwater to indoor air may occur at future onsite residences. The exposure pathway cannot be quantified, however, because the groundwater in the area is too shallow (<5 feet below ground) to use the Johnson and Ettinger Model. It is expected that future indoor air exposures in buildings constructed in the area would be at unacceptable levels because of the high concentrations (well above groundwater-to-indoor air screening levels) and shallow groundwater depths.

- **Soil Exposures by Future Trespassers—**In the future, trespassers may gain access to the site if the fence is not maintained and the site is not developed. Potential exposures to trespassers were not quantified because the soil risk estimates quantified for a current

industrial worker can be used to conservatively represent potential risks to trespassers, since industrial workers are exposed at a greater frequency and duration.

In the area downgradient of former Building 220, vapor intrusion from shallow groundwater to indoor air may occur at current and future offsite residences (along Stratford Avenue), in addition to future onsite residences noted above. The indoor air exposure pathways cannot be quantified because the groundwater in the area is too shallow (less than 5 feet below ground) to use the Johnson and Ettinger Model. If the VOC plume expands in the future, indoor air concentrations at offsite residences along Stratford Avenue could increase.

2.7.1.3 Toxicity Assessment

The toxicity assessment describes the relationship between magnitude of exposure to a chemical and adverse health effects. It provides, where possible, a numerical estimate of the increased likelihood and severity of adverse effects associated with chemical exposure (USEPA 1989).

For the purpose of toxicity assessment, COPCs can be classified into two broad categories: carcinogens and noncarcinogens. The classifications are used because health risks are calculated differently for carcinogenic and noncarcinogenic effects. USEPA develops separate toxicity values for carcinogenic and noncarcinogenic effects, representing the potential magnitude of adverse health effects associated with exposure to chemicals. Toxicity studies with laboratory animals or epidemiological studies of human populations provide the data used to develop toxicity values. The values represent allowable levels of exposure based upon the results of toxicity studies or epidemiological studies. The toxicity values are combined with the exposure estimates to develop numerical estimates of carcinogenic and noncarcinogenic health risks in the risk characterization process.

The following hierarchy (USEPA 2003) was used to obtain toxicity values (oral cancer slope factors, inhalation unit risk factors, oral reference doses, and inhalation reference concentrations) for COPCs:

- **Tier 1 Source, the Integrated Risk Information System** prepared and maintained by USEPA. The Integrated Risk Information System contains toxicity data and USEPA regulatory information on specific chemicals.
- **Tier 2 Source, Provisional Peer-Reviewed Toxicity Values,** a database of provisional toxicity values prepared and maintained by USEPA.
- **Tier 3 Sources:**
  - California Environmental Protection Agency toxicity database
  - USEPA's Health Effects Assessment Summary Tables
  - Minimal Risk Levels identified by the Agency for Toxic Substances and Disease Registry for intermediate inhalation exposures

The toxicity values used in the HHRA are provided in the RI report (CH2M HILL 2009).

2.7.1.4 Risk Characterization

Table 2-20 summarizes the cumulative excess lifetime cancer risk (ELCR) and screening hazard index (HI) for each receptor. The ELCR is a measure of risk of adverse health effects

associated with the exposure to cause cancer. An individual ELCR of 1×10^{-5} is an upper-bound estimate of the probability that one additional case of cancer will occur in 100,000 people over a 70-year lifetime as a result of individual exposure to the chemical. *Excess* means risk beyond that from other causes (American Cancer Society statistics show the probability of risk from other causes—that is, background risk—to be as high as one in three). The HI is a measure of the risk of adverse health effects associated with noncancer effects. An HI of 1.0 or less is considered highly unlikely to cause noncancer adverse effects even if exposure continues for a lifetime.

2.7.1.5 Identification of Chemicals of Concern

Table 2-20 lists COCs contributing significantly to the risk estimate in the environmental medium causing the target level exceedance) for receptors with risk estimates exceeding risk thresholds or triggers (1×10^{-4} ELCR or a target organ-specific HI of 1.0). For the environmental medium driving the risk estimates, COPCs with an individual ELCR greater than 1×10^{-5} or with an individual HI greater than 0.1 contributing to a target organ HI greater than 1.0 were identified as COCs.

The following exposure scenarios exceed risk triggers, with risk estimates driven by the indicated exposure pathways:

- Hypothetical future potable use of offsite groundwater by ingestion, dermal contact, and inhalation exposures by residents based on groundwater quality in monitoring wells installed in and along the right-of-way on Stratford Avenue
- Future exposure of onsite residents (incidental ingestion) to soil at Exposure Units E, I, J, and K (Figure 2-12)
- Future exposure of onsite construction workers to groundwater (in excavations in the area downgradient of former Building 220) by dermal contact
- Hypothetical future potable use of onsite groundwater by ingestion, dermal contact, and inhalation exposures by residents

The following COCs were identified at the former Hanley Area:

- Onsite Surface Soil (Sitewide): Current Industrial Workers—None
- Onsite Subsurface Soil (Sitewide): Future Construction Workers—None
- Onsite Subsurface Soil (Exposure Units A through L; Figure 2-12): Future Residents—
  - Exposure Unit A—None
  - Exposure Unit B—None
  - Exposure Unit C—None
  - Exposure Unit D—None
  - Exposure Unit E—Antimony and thallium
  - Exposure Unit F—None
  - Exposure Unit G—None
  - Exposure Unit H—None
  - Exposure Unit I—Thallium
  - Exposure Unit J—Thallium

  - Exposure Unit K—Thallium
  - Exposure Unit L—None

- Groundwater (Area Downgradient of Former Building 220)
  - Hypothetical Potable Use (Future Residents)—1,1,1,2-tetrachloroethane (TeCA), 1,1,2,2-tetrachloroethene, 1,1,2-trichloroethane, 1,2-DCA, benzene, CT, chloroform, *cis*-1,2-DCE, manganese, naphthalene, PCE, *trans*-1,2-DCE, and TCE
  - Groundwater in Excavations (Future Construction Workers)—CT and PCE
- Onsite Groundwater (Sitewide Excluding Area Downgradient of Building 220)
  - Hypothetical Potable Use (Future Residents)—1,2-DCA and CT
- Offsite Groundwater (Along Stratford Avenue)
  - Future Construction Worker Exposures—None
- Offsite Groundwater (Along Stratford Avenue)
  - Hypothetical Potable Use (Future Residents)—Chloroform, 1,2-DCA, manganese, PCE, and TCE—The risk estimates for this scenario are driven by the elevated concentrations detected in MW-110, situated in the middle of Stratford Avenue

VOCs are present in site groundwater in an area downgradient of former Building 220. Vapor intrusion from shallow groundwater to indoor air may occur at future onsite residences. Because the groundwater in the area is very shallow (ranging from less than 1 foot to 5 feet below ground), potential indoor air concentrations resulting from vapor intrusion cannot be modeled using the Johnson and Ettinger Model. Future indoor air exposures within buildings constructed in the area may be at unacceptable levels because of high concentrations detected in groundwater and shallow groundwater depths.

The following exposure scenarios do not exceed risk triggers:

- Current surface soil exposures by industrial workers and offsite residents on the Job Corps property
- Future subsurface soil exposures by construction workers
- Future subsurface soil exposures by residents at Exposure Units A, B, C, D, F, G, H, and L (Figure 2-12)
- Future offsite groundwater exposures (in excavations) by construction workers along Stratford Avenue
- Indoor air concentrations at offsite residences (via vapor intrusion) along Stratford Avenue

An assumption was made that the concentrations of chemicals in the media evaluated remain constant over time. The assumption could over- or under-estimate risk, depending on the degree of chemical degradation or transport to other media. For instance, if the VOC plume expands in the future, groundwater or indoor air concentrations at offsite residences

could increase, in which case future risk presented in the HHRA may be underestimated for offsite residents.

2.7.2 Ecological Risk Assessment

Potential risks to terrestrial plants and soil invertebrates are indicated for direct exposure to chromium, lead, manganese, selenium, thallium, vanadium, and zinc. When interpreting the results for chromium and vanadium, it is important to note that the screening value for chromium is very conservative, and that the screening value for vanadium is based on other exposure routes. Ecological soil screening levels (Eco-SSLs; USEPA 2008) for terrestrial plants and soil invertebrates could not be derived for chromium and vanadium because too few studies have been conducted, but the effect levels listed in the Eco-SSL studies were much higher than the screening values used in the ecological risk assessment and generally higher than the average concentrations at the site. Although site-specific background data are unavailable, the 50th percentile background levels reported in the Eco-SSLs for chromium and vanadium and the eastern United States are very similar to the average concentrations at the site.

Selenium concentrations exceeded the Eco-SSL for plants, but selenium is not expected to pose risk to terrestrial plants because the Eco-SSL was only slightly exceeded. The Eco-SSL is based primarily on toxicity to agricultural crops, which are more sensitive to selenium than other terrestrial plants. Furthermore, the soils at the site are expected to be slightly acidic and less oxidized, and bioavailable forms of selenium are expected to be present. As with chromium and vanadium, selenium levels at the site appear similar to the background levels in the eastern United States. Average concentrations of lead, manganese, and zinc exceeded Eco-SSLs only slightly.

Available habitat is limited to enclosed and maintained grassy areas. Although plant and invertebrate receptors are present at the site, the habitat does not represent a natural ecosystem, as it is controlled by human activity. The potential for adverse effects to terrestrial plants and soil invertebrates exists, but the nature of the habitat in the regularly disturbed area is likely to limit the diversity and abundance of terrestrial plants and soil invertebrates and the overall potential for adverse effects to receptor communities. The conditions suggest that risks are negligible, and no further investigation is warranted.

2.7.3 Basis for Action

The response action selected in this decision document is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site that may present an imminent and substantial endangerment to public health or welfare.

2.8 Remedial Action Objectives

RAOs are goals specific to media or operable units for protecting human health and the environment. They specify the COCs, media of interest, and exposure pathways. Typically, RAOs are developed based on the exposure pathways found to pose potentially unacceptable risks according to the results of the HHRA and ecological risk assessment and to satisfy ARARs.

RAOs were developed for the former Hanley Area in part based on the contaminant levels and exposure pathways found to pose potentially unacceptable risk to human health, as determined during the RI. The RAOs, remediation goals, and remediation strategies developed address constituents posing unacceptable risk under the exposure scenarios evaluated during the RI.

COC concentrations in various environmental media at the site pose unacceptable risks to human health based on the various exposure pathways. Therefore, the following RAOs were developed for the site:

- Prevent unacceptable risk to future human receptors (onsite and offsite) from potential vapor intrusion to indoor air.
- Prevent unacceptable risk to residents from ingestion of onsite soil containing antimony and thallium within Exposure Units E, I, J, and K.
- Prevent unacceptable risk to onsite construction workers from dermal contact with groundwater containing CT and PCE.
- Remove soil to prevent future human exposure to onsite soil with elevated concentrations of arsenic, lead, and Aroclor 1260 at the following historical sample locations:
  - Sample NS03A arsenic at 44 mg/kg; lead at 5,840 mg/kg
  - Sample NS08A arsenic at 67.7 mg/kg
  - Sample SS-001 Aroclor 1260 at 1.4 mg/kg
  - Sample SED-001 Aroclor 1260 at 569 mg/kg
  - Sample SS-218A-2 lead at 2,724 mg/kg
  - Sample SS-219B arsenic at 108 mg/kg
  - Sample SS-219C arsenic at 68.8 mg/kg
  - Sample SS55A Aroclor 1260 at 18,200 mg/kg
- Remove the sediment within onsite powder wells to prevent future human exposures.

As stated in Section 2.7.1.2, groundwater COCs were identified for the potable use exposure pathway. However, St. Louis Ordinance 66777, which prohibits the installation of potable water supply wells, is already in place as an institutional control and removes the exposure pathway for onsite and offsite receptors to use the groundwater as a potable resource. For this reason, a RAO associated with the potable use exposure pathway was not necessary. In the unlikely event that the City Ordinance 66777 is repealed, the U.S. Army and MDNR will evaluate alternative measures to protect current and future residents from consuming groundwater as a potable drinking water source.

2.9 Description of Alternatives

The FS report (CH2M HILL 2010) developed remedial alternatives for the former Hanley Area using the following process:

1. Develop RAOs based on risk assessment findings and ARARs (Section 2.8).

2. Evaluate PRGs based on regulatory requirements, standards, and guidance to meet the site-specific RAOs. The following PRGs were developed in the FS:

   - Soil PRGs were developed to prevent unacceptable risk to residents from ingestion of onsite soil containing thallium and antimony within Exposure Units E, I, J, and K and to prevent unacceptable risk to human receptors to onsite soil containing elevated concentrations of arsenic, lead, and Aroclor 1260.

   - Groundwater PRGs were developed to prevent unacceptable risk to onsite construction workers for dermal contact with CT and PCE.

3. TTZs were defined for the areas of where soil and groundwater concentrations exceed the PRGs.

4. Develop remedial alternatives by considering general response actions: media-specific actions that satisfy RAOs. Actions for mitigating risk posed by affected media may be applied individually or in combination. General response actions for unsaturated surface soil and sediment were not developed because the lead agency (U.S. Army) and lead regulatory agency (MDNR) agreed to address COCs in soil by removal and offsite disposal. Since removal and disposal activities are being conducted for metals and Aroclor 1260 within and near the areas with thallium concentrations above the PRGs, removal and disposal is the recommended remedial action to address thallium in soil. General response actions identified for groundwater consisted of no action, institutional controls, monitoring, containment, in situ treatment, collection and ex situ treatment, removal, disposal, and discharge.

5. Within each remaining general response action, remedial technologies were identified and screened using the following criteria:

   - **Effectiveness** is the ability of the technology or process option to perform adequately to achieve the remedial objectives alone or as part of an overall system.

   - **Implementability** refers to the relative degree of difficulty expected in implementing a particular measure under practical technical, regulatory, and schedule constraints.

   - **Relative cost** is comparative only and is judged similarly to effectiveness. It is used to preclude further evaluation of process options that are very costly when there are other choices that perform similar functions with comparable effectiveness. It includes construction and long-term O&M costs.

   Technologies and process options were screened based on professional experience, published sources, and other relevant documentation. Details regarding the screening of technologies and process options are provided in the FS report (CH2M HILL 2010). The technologies retained following screening consisted of no action, monitoring, in situ treatment, removal, and disposal.

The technologies that remained following screening were assembled into remedial alternatives that meet the RAOs for the site. The following remedial alternatives were evaluated:

- Alternative 1—No Action
- Alternative 2—In Situ Groundwater Treatment Using Thermal Technologies, Soil and Powder Well Sediment Removal, and Offsite Disposal
- Alternative 3—In Situ Groundwater Treatment using Chemical Processes and Soil Mixing, Soil and Powder Well Sediment Removal, and Offsite Disposal
- Alternative 4—Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal, and Offsite Disposal

The major components of the remedial alternatives identified are defined in the following subsections.

2.9.1 Alternative 1—No Action

Alternative 1 consists of taking no action. The NCP requires that a No-Action Alternative be retained throughout the FS process as a baseline for comparison to the other approaches. No action would leave affected soil, groundwater, and powder well sediment in place at the site. No mechanisms would be in place to prevent or control exposure to contaminants. Alternative 1 allows natural processes such as dispersion, degradation, and dilution to reduce contaminants. Lack of active cleanup or controls may allow receptors to be exposed to contaminants. There are no capital or O&M costs for the Alternative 1. Therefore, a cost estimate was not necessary.

2.9.2 Common Elements among Alternatives 2, 3, and 4

Common elements among Alternatives 2, 3, and 4 include the following:

- Soil and powder well sediment removal and offsite disposal
- Vapor intrusion evaluation
- Plume C monitoring
- LUCs
- Five-year reviews

Alternatives 2, 3, and 4 all include removal and offsite disposal of surface soil contaminated with metals and Aroclor 1260 to address soil TTZs (shown as soil removal areas in Figure 2-13), powder well sediment removal, a vapor intrusion evaluation, and LUCs. Five-year site reviews are included in each alternative as they are required for sites containing COC concentrations above respective remediation goals. The common elements are briefly summarized in the following subsections. They are discussed in greater detail in Section 2.12.

The common elements have been included as part of the remedy and cost estimates for each of the three alternatives. For cost estimating purposes, the estimated duration of Alternatives 2, 3, and 4 was chosen as 50 years. Although the actual monitoring period may be 100 years, cost estimating periods beyond 50 years have little effect on the present worth estimate.

2.9.2.1 Soil and Powder Well Sediment Removal and Offsite Disposal

This common element consists of excavating areas of surface soil contaminated with arsenic, lead, thallium, and Aroclor 1260, transporting it offsite, and disposing of it at a permitted landfill. Samples of the soil will be collected for disposal characterization. Before excavation, hand auger soil borings will be advanced to delineate the presence of COCs in soils around previous sample locations. Soil removal areas are shown on Figure 2-13. Note that samples obtained at many of the historic soil sample locations shown in Figure 2-13 were composite samples. Following excavation, each area will be backfilled, regraded, reseeded, and restored to its original condition. Clean, imported material will be used as backfill.

As part of the remedial action at the former Hanley Area, the 22 powder wells will be decommissioned. The sediment will be removed and disposed based on characterization sampling, and the wells will be filled with clean, imported soil to ground surface. The sediment will be disposed of offsite at a permitted landfill.

2.9.2.2 Vapor Intrusion Evaluation

Based on the uncertainty of indoor air risk, the vapor intrusion pathway will be further evaluated as part of the site remedy. Several components may be included in the evaluation, such as:

- Vapor migration information collected from similar sites
- Site-specific VOC data
- Data collection methods developed by the industry
- Vapor intrusion modeling
- Potential risk based on current or future structures

For cost estimating purposes, the vapor intrusion evaluation will include monitoring the VOCs in groundwater that were observed above screening levels that were developed in the FS and discussed further in Section 2.12.2.3. COC concentrations above the screening levels will be used as a trigger for determining whether additional sampling and/or mitigation actions are necessary.

Because the study and mitigation of vapor intrusion is an evolving field, the use of groundwater analytical results as a vapor intrusion indicator may be replaced with modeling or other vapor sampling methods as new technologies become available during the remedial design, remedial action, or long-term management of the site. Data collected as part of the remedial design may be used to adjust the remedial approach if appropriate.

2.9.2.3 Plume C Monitoring

Groundwater monitoring will be performed within Plume C to confirm that the exposure pathway between construction workers and contaminated groundwater remains incomplete as long as concentrations of CT remain above the risk threshold for direct contact risk to construction workers.

2.9.2.4 Land Use Controls

LUCs will be implemented onsite at the former Hanley Area over the area where groundwater concentrations exceed screening levels, unless future vapor intrusion evaluations confirm that risk thresholds have not been exceeded. Within the LUC area described above, a second LUC will be established over the Plume C footprint as long as CT

concentrations remain above the groundwater remediation goal. Figure 2-14 presents the LUC boundaries at the former Hanley Area. LUCs are discussed further in Section 2.12.2.5.

2.9.2.5 Five-Year Reviews

Five-year site reviews are a common element to be included as long as hazardous substances remain at the site at concentrations that do not allow unlimited use and unrestricted exposure. Five year reviews are discussed further in Section 2.12.2.6.

2.9.3 Alternative 2—In Situ Groundwater Treatment Using Thermal Technologies

Alternative 2 relies on in situ thermal technologies to decrease PCE concentrations within the Plume A TTZ (Figure 2-15), which corresponds to the area where groundwater concentrations exceed construction worker PRGs but does not extend into Stratford Avenue.

Thermal treatment processes work by increasing the temperature of the contaminated soil and groundwater through the introduction of steam or electrical energy. The primary in situ heating processes include steam-enhanced extraction, electrical resistance heating, and thermal conductive heating (TCH). At the site, TCH is considered the most robust technology because of the clayey hydrogeologic setting. Recent applications have shown that electrical resistance heating has not performed as well as TCH in clayey sites, since electrical resistance heating relies on saturated soil conditions in the treatment zone to conduct electrical current effectively. Therefore, TCH technology was used for cost estimating purposes.

Estimated Capital Cost:	$2,638,000
Estimated Annual O&M (Years 1 and 2):	$67,000
Estimated Annual O&M (After Year 2):	$36,000
Estimated Periodic Cost (Five-year reviews):	$15,000
Estimated Present Worth:	$3,754,000

2.9.4 Alternative 3—In Situ Groundwater Treatment Using Chemical Processes and Soil Mixing

Alternative 3 relies on in situ groundwater treatment using chemical processes known as chemical reduction or chemical oxidation to decrease PCE concentrations in the Plume A TTZ (Figure 2-15). The TTZ will be treated by applying a chemical reductant or oxidant to soil and groundwater in place. Chemical reduction using soil mixing procedures was selected as the basis of the cost estimate for this alternative.

Mechanical soil mixing involves using an in situ blender (such as a large-diameter auger or trenching machine) to effectively distribute chemical amendments throughout the soil medium to treat PCE through reductive dechlorination. The process has been successfully applied at other sites. This process is practicable and implementable at the site and is compatible with the friable clayey soils found at the site.

A one-pass trenching machine method for soil mixing was assumed in this alternative for cost estimating purposes. The one-pass trenching machine resembles a large chainsaw mounted on an excavator platform. The rotating cutting chain mixes the amendment and soil as it travels along its path. During mixing operations, two soil samples will be collected each day at various depths to verify proper mixing and usage of the amendment.

After implementation of soil mixing, groundwater samples will be collected from within the treatment zone and downgradient of the treatment zone to evaluate the impact on COC concentrations in groundwater. Fieldwork to complete soil mixing activities is expected to take about 1 month, with a treatment time of roughly 3 months based on the properties of the zero valent iron and chemical concentrations within the Plume A TTZ. PCE concentrations in groundwater may be below remediation goals within a year. Five-year site reviews will be conducted.

Estimated Capital Cost:	$1,772,000
Estimated Annual O&M (Years 1 and 2):	$67,000
Estimated Annual O&M (After Year 2):	$36,000
Estimated Periodic Cost (Five-year reviews):	$15,000
Estimated Present Worth:	$2,888,000

2.9.5 Alternative 4—Groundwater Source Removal by Excavation

Alternative 4 relies on soil removal to decrease PCE concentrations in groundwater within the Plume A TTZ. Soil excavation immediately removes the contaminated media. Alternative 4 combines physical soil removal with disposal at a permitted landfill. The TTZ is consistent with Alternatives 2 and 3 (Figure 2-15). A remedial design sampling event will delineate the TTZ before soil removal. Contaminated soil will be removed using a backhoe. Contaminated soil above and below the groundwater table will be excavated from the TTZ. Some contaminated soil may have to be left in place if it is not safe or practical to be removed (for example, would require excavation too close to utilities or the roadway). Excavation near roadways or utilities will be conducted in a manner that protects structural integrity, such as the use of sheet piling.

Excavated soil may be staged temporarily onsite until waste characterization sampling is completed. For estimating purposes, it is assumed that part of the soil will be classified as hazardous waste. Excavated soil will be placed on plastic sheeting and covered with plastic to control dust and emissions and to shield the soil from precipitation. Best management stormwater pollution prevention measures will be implemented.

Following excavation, clean, imported material will be used to backfill the excavation. Fill materials will be placed in the excavation in 1-foot lifts and compacted. The area will be regraded, reseeded, and restored to its original condition. Fieldwork to complete excavation activities is expected to take approximately 2 months, with an immediate treatment time. Five-year site reviews will be conducted.

Estimated Capital Cost:	$1,971,000
Estimated Annual O&M (Years 1 and 2):	$67,000
Estimated Annual O&M (After Year 2):	$36,000
Estimated Periodic Cost (Five-year reviews):	$15,000
Estimated Present Worth:	$3,087,000

2.10 Comparative Analysis of Alternatives

The NCP uses nine criteria to evaluate remedial alternatives individually and comparatively to help select a preferred alternative, as outlined in 40 *Code of Federal Regulations* §300.430 (f)(1)(i). They are classified as threshold, balancing, and modifying criteria.

Threshold criteria are standards that an alternative must meet for it to be eligible for selection as a remedial action. There is little flexibility in meeting the threshold criteria—the alternative must meet them or it is unacceptable. The following are the threshold criteria:

- Overall protection of human health and the environment
- Compliance with ARARs

Balancing criteria weigh the tradeoffs among alternatives. They represent the standards upon which the detailed evaluation and comparative analysis of alternatives are based. In general, a high rating on one balancing criterion can offset a low rating on another. The following are balancing criteria:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying criteria are the following:

- Community acceptance
- State/support agency acceptance

Each alternative was evaluated in the FS to determine how well it satisfies the seven feasibility evaluation criterion (the threshold and balancing criteria described above) and how it compares to the other alternatives under consideration. Table 2-21 shows the results of the evaluation for each alternative with respect to the criteria listed above.

2.10.1 Overall Protection of Human Health and the Environment

All of the alternatives, except Alternative 1 (No Action), provide protection of human health and the environment by meeting the RAOs and are rated high in this category. Alternative 1 does not provide protection of human health and the environment; therefore, it is rated low in this category.

2.10.2 Compliance with ARARs

Alternative 1 is in compliance with the action-specific ARARs like Alternatives 2 through 4. However, it is not in compliance with the chemical-specific ARARs because unacceptable risks could still exist for construction workers to groundwater or to receptors associated with COCs in soil. Alternatives 2, 3, and 4 are in compliance because the remediation goals would eventually be met at the site. Alternatives 2, 3, and 4 are rated high, and Alternative 1 is rated low for not meeting the ARARs. The ARARs are presented in Table 2-24.

2.10.3 Long-Term Effectiveness and Permanence

Under all the alternatives there would be no residual risks to potable water use receptors because of an existing city ordinance. Risks to construction workers would remain due to no controls under Alternative 1. Alternatives 2, 3, and 4 would have no residual risk to soil COCs, and risks to the construction worker would be managed through treatment and control of exposure. Alternative 1 would naturally attenuate, slowly decrease COC mass, but the

amount of the decrease would remain unknown. Alternatives 2, 3, and 4 would remove the COCs to their remediation goals, and nearby residents would only have a temporary impact due to the noise and increase in roadway traffic because of the excavation activities. Alternatives 2, 3, and 4 were rated high because of their long-term effectiveness and permanence; however, Alternative 1 was rated low.

2.10.4 Reduction of Toxicity, Mobility, or Volume through Treatment

For Alternatives 2, 3, and 4, most of the contaminated area would be destroyed or removed from the site resulting in significant reduction of toxicity, mobility, or volume. Natural attenuation would then slowly decrease concentrations of COCs in groundwater over time. Alternative 1 would leave the contamination in place and natural attenuation over time would slowly decrease the VOC concentrations, however the amount of the decrease would remain unknown. Alternatives 1, no action, and 4, removal by excavation, would not use treatment to decrease the mass of contaminated media. However, Alternatives 2 and 3 would both use treatment to address groundwater, therefore meeting the preference for treatment. Surface soil and sediment from powder wells would not be treated but would instead be excavated and disposed offsite. Alternatives 1 and 4 received low rankings because treatment is not part of the alternative. Alternatives 2 and 3 received the highest rating in this category.

2.10.5 Short-Term Effectiveness

Alternative 1 would not achieve protection and therefore was rated low. Alternatives 2, 3, and 4 would achieve protection rapidly onsite due to the existing ordinance and depth to groundwater. However, groundwater under Stratford Avenue would not be addressed during the remedial action; therefore, protection would not be achieved rapidly offsite.

2.10.6 Implementability

Alternatives 1 and 4 would be the easiest to implement and therefore were rated the highest because Alternative 1 does not require an active remedy and Alternative 4 does not require treatment. Alternatives 2 and 3 would be feasible but complex due to the nature of the treatment processes. Alternatives 2, 3, and 4 would be reliable and feasible, and materials and services are readily available, except Alternative 2 would likely require an additional power source. Both Alternatives 2 and 3 were rated moderately.

2.10.7 Cost

Alternative 1 costs much less than the other alternatives and is rated highly. Although Alternative 1 is the least costly of the remedial alternatives, it is not protective of human health and the environment. The cost of Alternative 2 is the highest followed by Alternatives 4 and 3. The present worth of Alternatives 2, 3, and 4 is presented in Sections 2.9.3, 2.9.4, and 2.9.5, respectively.

2.10.8 State/Support Agency Acceptance

The State has expressed support for Alternatives 2, 3, and 4. The State does not believe that Alternative 1 provides adequate protection of human health and environment.

2.10.9 Community Acceptance

As noted in Section 2.3, the Proposed Plan for the former Hanley Area was made available for public review and comment on November 25, 2010. A public meeting was held on December 13, 2010, and the public comment period was established from November 29 through December 29, 2010. The community did not submit written comments during the public comment period, and they did not raise concerns regarding Alternative 3 during the public meeting. Based on the absence of public comments or concerns, community acceptance of Alternative 3 is assumed..

2.11 Principal Threat Waste

The NCP expects that treatment will be used to address principal threat wastes to the extent practicable to reduce their toxicity, mobility, or volume. Principal threat wastes are defined by USEPA as "source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur" (USEPA 1991). Although principal threat waste was not observed during previous investigations at the former Hanley Area, PCE observed in soil at soil boring SB-023 (3,200,000 µg/kg) at 25 to 26 feet below ground (Figure 2-15) could indicate the presence of DNAPL above the weathered shale. As shown in Figure 2-15, SB-023 lies within the soil TTZ that would be addressed under Alternatives 2, 3, and 4. Alternatives 2 and 3 would include in situ treatment (thermal technologies and chemical processes/soil mixing, respectively) to address potential principal threat waste. Alternative 4 would not use treatment to address the soil TTZ; instead, it would involve the excavation and offsite disposal of the material. Depending on waste characterization of the excavated material, offsite treatment could be required before the material can be permanently disposed.

2.12 Selected Remedy

The selected remedy for the former Hanley Area is Alternative 3—In Situ Groundwater Treatment using Chemical Processes and Soil Mixing, Soil and Powder Well Sediment Removal, and Offsite Disposal. Figures 2-13, 2-14, and 2-15 depict the primary features of the selected remedy.

2.12.1 Summary of the Rationale for the Selected Remedy

As presented in Table 2-21, Alternatives 2, 3, and 4 each protect human health and the environment, comply with ARARs, and achieve long-term and short-term effectiveness by addressing risks to current and future receptors. Each alternative is implementable, although Alternative 4 is more implementable than Alternative 3, which, in turn, is slightly more implementable than Alternative 2.

Alternative 3 was selected over Alternative 2 because Alternative 3 is more cost-effective and slightly more implementable. Alternative 3 was selected over Alternative 4 because chemical processes and soil mixing (in situ groundwater treatment) addresses the balancing criterion of reduction of toxicity, mobility, or volume through treatment, while excavation and offsite disposal under Alternative 4 does not. Alternative 4 would move the contaminated media from Plume A from one location to another, while Alternative 3 would

reduce contaminant toxicity, mobility, and volume in place, without requiring offsite transport and disposal.

2.12.2 Description of the Selected Remedy

The selected remedy consists of in situ groundwater treatment using chemical processes and soil mixing, soil and powder well sediment removal offsite disposal, vapor intrusion evaluation, LUCs, and five-year reviews.

2.12.2.1 In Situ Groundwater Treatment Using Chemical Processes and Soil Mixing

Alternative 3 relies on in situ groundwater treatment using chemical processes known as chemical reduction or chemical oxidation to decrease PCE concentrations in the Plume A TTZ (Figure 2-15). The TTZ will be treated by applying a chemical reductant or oxidant to in situ soil and groundwater. Chemical reduction using soil mixing procedures was selected as the basis of the cost estimate for this alternative. Section 2.9.4 presents a detailed description of this component of the selected remedy.

2.12.2.2 Soil and Powder Well Sediment Removal and Offsite Disposal

Soil removal activities consist of excavating areas of surface soil contaminated with metals and Aroclor 1260, transporting the soil offsite, and disposing of it at a permitted landfill. Before excavation, hand auger soil borings will be advanced to delineate the presence of COCs in soils around the following sample locations:

- Sample SS-218A-1 thallium at 8.64 J mg/kg
- Sample SS-218A-3 thallium at 7.67 J mg/kg
- Sample NS03A arsenic 44 at mg/kg; lead at 5,840 mg/kg
- Sample NS08A arsenic 67.7 at mg/kg
- Sample SS-001 Aroclor 1260 at 1.44 mg/kg
- Sample SED-001 Aroclor 1260 at 569 mg/kg
- Sample SS-218A lead at 2,724 mg/kg
- Sample SS-219B arsenic at 108 mg/kg
- Sample SS-219C arsenic at 68.8 mg/kg
- Sample SS55A Aroclor 1260 at 18,200 mg/kg

Utilities will be marked before excavation. Excavation will be conducted using a backhoe. It is assumed for cost estimating purposes that excavation will be required to a depth of 2 feet below ground in areas not covered with concrete, but the depth will be determined based on confirmation sampling conducted before excavation. Soil samples from the area will be collected and analyzed for the corresponding COC to determine excavation limits. Figure 2-13 shows estimated excavation limits. Samples of the soil will be collected for disposal characterization. The excavated soil will be disposed of offsite at a permitted Subtitle D landfill. The alternative assumes that the excavated soil will not be characterized as hazardous waste. Following excavation and confirmation sampling, the area will be backfilled, regraded, reseeded, and restored to its original condition. Clean, imported material will be used as backfill.

As part of the remedial action at the former Hanley Area, the 22 powder wells shown in Figure 2-13 will be decommissioned. The sediment will be removed and disposed of based

on characterization sampling, and the wells will be filled with clean, imported soil to ground surface. The sediment will be disposed of offsite at a permitted landfill.

2.12.2.3 Vapor Intrusion Evaluation

Based on the uncertainty of indoor air risk, the vapor intrusion pathway will be further evaluated as part of the site remedy. Several components may be included in the evaluation, such as:

- Vapor migration information collected from similar sites
- Site-specific VOC data
- Data collection methods developed by the industry
- Vapor intrusion modeling
- Potential risk based on current or future structures

For cost estimating purposes, the vapor intrusion evaluation will include monitoring the VOCs in groundwater that were observed above the screening levels listed below.

- Benzene: 5 µg/L
- CT: 5 µg/L
- Chloroform: 1.9 µg/L
- 1,2-DCA: 5 µg/L
- *cis*-1,2-DCE: 70 µg/L
- *trans*-1,2-DCE: 100 µg/L
- Methylene chloride: 5 µg/L
- Naphthalene: 6.2 µg/L
- 1,1,1,2-TeCA: 5.2 µg/L
- 1,1,2,2-TeCA: 0.67 µg/L
- 1,1,2-TCA: 5 µg/L
- PCE: 5 µg/L
- TCE: 5 µg/L
- Vinyl chloride: 2 µg/L

Except for chloroform, naphthalene, 1,1,1,2-TeCA, and 1,1,2,2-TeCA the screening levels are the MCLs. For these other four chemicals, resident risk-based screening levels for potable groundwater use were developed.

Groundwater COC concentrations above the screening levels will be used as a trigger for determining whether additional sampling and/or mitigation actions are necessary. If groundwater concentrations exceed screening levels and are found to increase in monitoring wells along Stratford Avenue, or if other vapor intrusion evaluation measures conclude that there is risk to human receptors, additional sampling or mitigation actions, such as vapor barriers or in-home mitigation systems that vent indoor air to the atmosphere, will be implemented as part of the remedy. In accordance with the U.S. Army vapor intrusion policy, proper notification will be given to current property owners (onsite and offsite) of potential vapor intrusion risk.

The details of the vapor intrusion groundwater monitoring program, such as the number and location of wells to be sampled and the frequency, will be provided in the remedial design. For cost estimating, it is assumed that groundwater samples will be conducted quarterly for the first 2 years to establish groundwater trends and areas that may be susceptible to indoor air risk. Following year 2, groundwater samples will be collected annually to monitor the above VOCs at the site to identify changes in the plume that might affect the protectiveness of the selected remedy. Because the study and mitigation of vapor intrusion is an evolving field, the use of groundwater analytical results as a vapor intrusion indicator may be replaced with modeling or other vapor sampling methods as new technologies become available during the remedial design, remedial action, or long-term management of the site. Data collected as part of the remedial design may be used to adjust the remedial approach if appropriate.

2.12.2.4 Plume C Monitoring

Groundwater monitoring will be performed within Plume C to confirm that the exposure pathway between construction workers and contaminated groundwater remains incomplete as long as concentrations of CT remain above the risk threshold for direct contact risk to construction workers. Details of the monitoring program, such as number and location of wells to be sampled, will be provided in the remedial design. For cost estimating, it is assumed that groundwater samples and depth to water measurements will be conducted quarterly for the first 2 years, followed by a decrease in frequency to annual monitoring.

2.12.2.5 Land Use Controls

LUCs will be implemented onsite at the former Hanley Area in areas where groundwater concentrations exceed screening levels, unless future vapor intrusion evaluations confirm that risk thresholds have not been exceeded. The LUCs will require vapor intrusion evaluations at building construction sites at the former Hanley Area if groundwater concentrations have not fallen below screening levels in the vicinity of the construction site. If results of the vapor intrusion evaluation indicate potential vapor intrusion issues, or if a vapor intrusion evaluation is not performed, vapor intrusion mitigation technology will be applied to address soil gases that could enter the future building.

Within the LUC area described above, a second LUC will be established over the Plume C footprint as long as CT concentrations remain above the groundwater remediation goal. The LUC will prohibit construction activities below the groundwater table without proper health and safety training and personal protective equipment.

Figure 2-14 shows the LUC boundaries at the former Hanley Area.

The U.S. Army will prepare a Land Use Control Implementation Plan to define restrictions within the LUCs, establish LUC boundaries, and explain how they will be implemented, monitored, and enforced. Upon transfer of property ownership, the U.S. Army will include restrictions in the property deed to document the LUCs defined in the Land Use Control Implementation Plan.

2.12.2.6 Five-Year Reviews

Five-year site reviews are a common element to be included as long as hazardous substances remain at the site at concentrations that do not allow unlimited use and unrestricted exposure. The five-year reviews will be terminated once COCs are at or below the remediation goals, the vapor intrusion pathway is determined not to pose unacceptable risk as part of a future vapor intrusion evaluation (or chemical concentrations in groundwater fall below screening levels), and monitoring confirms that no unacceptable risks are posed by Plume C. Once these conditions are confirmed at the former Hanley Area, the U.S. Army will recommend that the five-year reviews be terminated. The basis for the recommendation will be documented in a final five-year review report that will be submitted for regulatory approval.

The five-year review will focus on vapor intrusion, the only potential risk that will not be actively addressed through remedial action, and monitoring results associated with Plume C to confirm that the construction worker risk exposure remains unchanged. The time that natural attenuation takes to return groundwater to the potable use levels is

estimated to be more than 84 years for Alternatives 2, 3, and 4—this duration is considered comparable to the time required to remove risk associated with vapor intrusion.

2.12.3 Summary of the Estimated Remedy Costs

The cost estimate for the selected remedy was developed as part of the FS and is based on the best available information regarding the anticipated scope of the selected remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the selected remedy. Major changes may be documented in a memorandum to the administrative record file, an explanation of significant differences, or a decision document amendment. Table 2-22 presents the estimated costs for the selected remedy. They are order-of-magnitude engineering costs and thus expected to be within +50 and -30 percent of the actual project cost.

2.12.4 Expected Outcomes of the Selected Remedy

The selected remedy for the former Hanley Area will address areas of soil and groundwater contamination that pose unacceptable risks to human health. The available onsite land use will be residential, because unacceptable risks to residents will be addressed through LUCs, City Ordinance 66777, in situ groundwater treatment, soil removal and offsite disposal, and the removal of sediment from powder wells. Soil PRGs developed during the FS will serve as the cleanup levels (remediation goals) for the soil removal action. Soil remediation goals are presented in Table 2-23.

Risks to onsite construction workers through dermal contact with groundwater will be addressed through chemical processes and soil mixing in the Plume A TTZ (Figure 2-15). Groundwater PRGs developed during the FS will serve as the remediation goals during chemical treatment and soil mixing. Table 2-23 shows groundwater remediation goals.

An onsite LUC boundary will be established around the area where groundwater concentrations exceed screening levels (Section 2.12.2.5) that indicate possible vapor intrusion concerns, unless future vapor intrusion evaluations confirm that risk thresholds have not been exceeded. The LUCs will require vapor intrusion evaluations at building construction sites at the former Hanley Area if groundwater concentrations have not fallen below screening levels in the vicinity of the construction site. If results of the vapor intrusion evaluation indicate potential vapor intrusion issues, or if a vapor intrusion evaluation is not performed, vapor intrusion mitigation technology will be applied to address soil gases that could enter the future building.

Within the LUC area described above, a second LUC will be established over Plume C as long as CT concentrations remain above the groundwater remediation goal established in the FS. The LUC will prohibit construction activities below the groundwater table without proper health and safety training and personal protective equipment.

Onsite and offsite use of groundwater for potable use is prohibited by City of St. Louis Ordinance 66777. The groundwater use restriction will remain in place for the foreseeable future. The time that natural attenuation takes to return groundwater to the potable use levels is estimated to be more than 84 years, which is considered comparable to the time required to remove risk associated with vapor intrusion.

The selected remedy will allow for beneficial reuse of the former Hanley Area, either by the U.S. Army or a future property owner. The remedy will allow the former Hanley Area to be developed as a "business and industrial development area" in accordance with the St. Louis Strategic Land Use Plan (Section 2.6). Alternatively, the property can be redeveloped as a residential area, subject to the LUCs and the provisions of City Ordinance 66777.

Because of the uncertainty of indoor air risk to future offsite residents, the potential migration of contaminated vapors from groundwater to indoor air will be further assessed through a vapor intrusion evaluation. If the evaluation reveals that indoor vapor concentrations in offsite residences pose an unacceptable risk to the residents and are related to the former Hanley Area, the U.S. Army will implement appropriate response measures to address the risk.

2.13 Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, and are cost-effective. In addition, it satisfies the statutory requirements of CERCLA and the five-year review requirements.

2.13.1 Protection of Human Health and Environment

The selected remedy protects human health and the environment. Existing or potential risks posed by the site will be eliminated, reduced, or controlled by the following response actions:

- Soil removal and offsite disposal will reduce risk to future onsite residents posed by surface soil to within USEPA's acceptable ELCR range of 10^{-4} to 10^{-6} for carcinogens and below the HI of 1.0 for noncarcinogens.
- Removal and offsite disposal of sediment, if present, at 22 powder well locations will prevent future human and ecological exposures to the material.
- In the Plume A TTZ, the response action will reduce risk that groundwater poses to future onsite construction workers to within the ELCR range of 10^{-4} to 10^{-6} for carcinogens and below the HI of 1.0 for noncarcinogens, which will be accomplished through in situ groundwater treatment using chemical processes and soil mixing.
- Groundwater monitoring within Plume C will confirm that the exposure pathway between construction workers and groundwater contaminated with CT remains incomplete because of the depth to the groundwater table.
- Because of the uncertainty of indoor air risk to future offsite residents, the potential migration of contaminated vapors from groundwater to indoor air will be further assessed through a vapor intrusion evaluation. If the evaluation reveals that indoor vapor concentrations in offsite residences pose an unacceptable risk to the residents and are related to the former Hanley Area, the U.S. Army will implement appropriate response measures to address the risk.
- Onsite LUCs will prohibit building construction that potentially exposes future industrial workers or residents to chemicals that migrate into indoor air by vapor intrusion.

- Onsite LUCs will prohibit construction activities that expose onsite construction workers to contaminated groundwater within Plume C.

Although it is not part of the selected remedy, City of St. Louis Ordinance 66777 provides protection against exposure to contaminated groundwater.

2.13.2 Compliance with ARARs

The selected remedy will comply with the ARARs presented in Table 2-24.

2.13.3 Cost-Effectiveness

The selected remedy is cost-effective and slightly less expensive than other alternatives considered, with the exception of Alternative 1, no action. Costs for Alternatives 2, 3, and 4 are presented in Sections 2.9.3, 2.9.4, and 2.9.5, respectively. A detailed cost estimate for the selected remedy, Alternative 3, is presented in Table 2-22.

2.13.4 Use of Permanent Solutions and Alternative Treatment Technology

The selected remedy provides long-term effectiveness and permanence because it will remove soil concentrations that pose a risk, and risks to the construction worker will be managed through treatment and control of exposure. The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner. The use of treatment in the selected remedy is discussed in Section 2.13.5.

2.13.5 Preference for Treatment as a Principal Element

The selected remedy satisfies the statutory preference for treatment as a principal element of the remedy. The selected remedy includes in situ groundwater treatment using chemical processes and soil mixing as a principal element.

2.13.6 Five-Year Review Requirements

As required by the NCP, five-year reviews will be conducted as long as hazardous substances remain at the site at concentrations that do not allow unlimited use and unrestricted exposure. The five-year reviews will be terminated once COCs are at or below the remediation goals, the vapor intrusion pathway is determined not to pose unacceptable risk as part of a future vapor intrusion evaluation (or chemical concentrations in groundwater fall below screening levels), and monitoring confirms that no unacceptable risks are posed by Plume C. Once these conditions are confirmed at the former Hanley Area, the U.S. Army will recommend that the five-year reviews be terminated. The basis for the recommendation will be documented in a final five-year review report that will be submitted for regulatory approval.

2.14 Documentation of Significant Changes

The Proposed Plan for the Former Hanley Area was released for public comment on November 29, 2010, and ended on December 29, 2010. The Proposed Plan identified in situ groundwater treatment using chemical processes and soil mixing, soil and powder well sediment removal, and offsite disposal as the Preferred Alternative for soil and

groundwater remediation. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

TABLE 2-1
1991 USATHAMA Soil RCRA TCLP Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

	Sample ID>>	**SS41A**	**SS44B**	**SS47B**	**SS51B**
	Sample Interval (ft)>>	**0-1**	**1-2**	**1-2**	**1-2**
RCRA Metals (mg/kg)	**TCLP Threshold**				
Arsenic	5	LT	LT	LT	LT
Barium	100	**0.781**	**0.956**	**0.881**	**0.682**
Cadmium	1	**0.00478**	**0.00559**	LT	LT
Chromium	5	LT	LT	LT	LT
Lead	5	LT	LT	LT	**0.0471**
Selenium	1	LT	LT	LT	LT
Silver	5	LT	LT	LT	LT

Notes:
Analyzed using ICAP method
Bold = Detected concentration
LT = Less than certified reporting limit
RCRA = Resource Conservation and Recovery Act
TCLP = Toxicity Characteristic Leaching Procedure
mg/kg = milligrams per kilogram

TABLE 2-2
1991 USATHAMA TAL Inorganics Soil Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Inorganics (mg/kg)	Reporting Limits	Sample ID>> / Sample Interval (ft)>> / Screening Levels (0-10')	SS40A 0-1	SS40B 1-2	SS41A 0-1	SS42A 0-1	SS43A 0-1	SS43B 1-2	SS44A 0-1	SS44B 1-2	SS45A 0-1	SS45B 1-2	SS46A 0-1	SS46B 1-2	SS47A 0-1	SS47B 1-2
Aluminum	14.1	7,700*	**10,400**	**12,100**	**6,980**	**11,600**	**12,400**	**12,900**	**8,640**	**10,600**	**9,320**	**9,320**	**7,160**	**8,710**	**11,100**	**12,000**
Antimony	3.8	3.1*	NRQ	NRQ	LT	NRQ	NRQ	NRQ	NRQ	LT	NRQ	NRQ	NRQ	LT	NRQ	LT
Arsenic	0.25	12.3	NRQ	NRQ	**8.92**	NRQ	NRQ	NRQ	NRQ	NRQ	**9.31**	NRQ	NRQ	**8.44**	NRQ	LT
Barium	29.6	1,600*	**204**	**184**	**120**	**194**	**394**	**224**	**249**	**248**	**286**	**188**	**196**	**431**	**244**	**292**
Beryllium	1.8	16*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Cadmium	3.05	3.9*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Calcium	59	-	**22,100**	**6,290**	**214,000**	**30,500**	**14,600**	**53,900**	**9,380**	**13,800**	**20,200**	**19,600**	**15,900**	**8,880**	**8,880**	**5,020**
Chromium	12.7	38	LT	**25.7**	LT	LT	**24.6**	LT	LT	**57.7**	LT	LT	LT	LT	LT	LT
Cyanide	0.92	120*	NRQ	NRQ	LT	NRQ	NRQ	NRQ	NRQ	LT	NRQ	NRQ	NRQ	LT	NRQ	LT
Cobalt	15	900	NRQ	NRQ	LT	NRQ	NRQ	NRQ	NRQ	LT	NRQ	NRQ	NRQ	LT	NRQ	LT
Copper	58.6	290*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Iron	50	5,500*	**18,700**	**20,300**	**10,700**	**17,630**	**19,100**	**17,900**	**5,800**	**17,300**	**16,400**	**14,700**	**15,100**	**6,000**	**17,100**	**19,100**
Lead	0.177	400	**39.3**	**10.3**	**115**	**74.4**	**78.7**	**34**	**27.1**	**28.5**	**56.5**	**15.9**	**18.3**	**71.9**	**94.5**	**18.8**
Magnesium	50	-	**6,970**	**5,400**	**15,500**	**6,750**	**5,260**	**6,670**	**6,010**	**6,720**	**4,890**	**3,860**	**10,200**	**5,020**	**5,000**	**4,010**
Manganese	0.275	350*	**723**	**720**	**601**	**708**	**1,040**	**753**	**1,060**	**898**	**638**	**795**	**1,070**	**921**	**991**	**1,030**
Mercury	0.05	2.3*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Nickel	12.6	130	**29**	**30.1**	**LT**	**27.1**	**28.5**	**26.8**	**29.2**	**32.2**	**28**	**25**	**27.9**	**28.3**	**29.0**	**31.2**
Potassium	37.5	-	**1,120**	**1,240**	**1,060**	**1,410**	**1,540**	**1,540**	**1,090**	**1,100**	**979**	**928**	**1,100**	**1,400**	**1,400**	**1,320**
Selenium	0.25	5	NRQ	NRQ	LT	NRQ	NRQ	NRQ	NRQ	LT	NRQ	NRQ	NRQ	LT	NRQ	LT
Silver	2.5	34	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Sodium	150	-	**581**	**584**	**508**	**475**	**484**	**321**	**515**	**678**	**362**	**444**	**609**	**440**	**346**	**419**
Thallium	31.3	0.7	NRQ	NRQ	LT	NRQ	NRQ	NRQ	NRQ	LT	NRQ	NRQ	NRQ	LT	NRQ	LT
Vanadium	13	39*	NRQ	NRQ	**33.3**	NRQ	NRQ	NRQ	NRQ	**44.1**	NRQ	NRQ	NRQ	**42.5**	NRQ	**50.2**
Zinc	30.2	2,300*	**141**	**92.6**	**119**	**132**	**197**	**105**	**104**	**98.3**	**220**	**94.1**	**84.6**	**177**	**152**	**107**

Notes:

Bold = Detected concentration

Gray highlight = A detected concentration above the selected screening level

Samples ending in 'A' were collected from a depth interval of 0-1 ft.

Samples ending in 'B' were collected from a depth interval of 1-2 ft.

LT = Less than certified reporting limit

mg/kg = milligrams per kilogram

NR = Not reported

NRQ = Analysis not requested for this sample

* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-2
1991 USATHAMA TAL Inorganics Soil Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Inorganics (mg/kg)	Reporting Limits	Sample ID>> / Sample Interval (ft)>> / Screening Levels (0-10')	SS48A 0-1	SS48B 1-2	SS49A 0-1	SS49B 1-2	SS50A 0-1	SS50B 1-2	SS51A 0-1	SS51B 1-2	SS52A 0-1	SS52B 1-2	SS53A 0-1	SS53B 1-2	SS54A 0-1	SS54B 1-2
Aluminum	14.1	7,700*	**11,100**	**10,400**	**9,410**	**9,440**	**9,630**	**9,590**	**10,700**	**10,500**	**8,570**	NR	**13,700**	**11,700**	**11,800**	**10,900**
Antimony	3.8	3.1*	NRQ	LT	NRQ	NRQ	NRQ	NRQ	NRQ	LT	NRQ	NR	NRQ	LT	NRQ	LT
Arsenic	0.25	12.3	NRQ	LT	NRQ	NRQ	NRQ	NRQ	NRQ	LT	NRQ	**10**	NRQ	**9.62**	NRQ	**7.37**
Barium	29.6	1,600*	**234**	**176**	**255**	**293**	**279**	**230**	**243**	**205**	**216**	NR	**313**	**283**	**233**	**211**
Beryllium	1.8	16*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Cadmium	3.05	3.9*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Calcium	59	-	**24,800**	**14,700**	**12,800**	**12,000**	**9,780**	**7,070**	**7,520**	**9,020**	**5,810**	**10,060**	**10,500**	**15,000**	**23,300**	**12,700**
Chromium	12.7	38	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Cyanide	0.92	120*	NRQ	LT	NRQ	NRQ	NRQ	NRQ	NRQ	LT	NRQ	LT	NRQ	LT	NRQ	LT
Cobalt	15	900	NRQ	LT	NRQ	NRQ	NRQ	NRQ	NRQ	LT	NRQ	LT	NRQ	LT	NRQ	LT
Copper	58.6	290*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Iron	50	5,500*	**18,600**	**15,400**	**16,500**	**17,800**	**4,600**	**15,900**	**17,500**	**16,700**	**4,900**	**16,100**	**19,800**	**18,100**	**17,700**	**17,200**
Lead	0.177	400	**40.7**	**11.9**	**23.4**	**65.9**	**25.7**	**17.9**	**26.2**	**23.8**	**28.9**	**14.9**	**21.6**	**23.6**	**52.4**	**23.3**
Magnesium	50	-	**4,760**	**5,870**	**5,930**	**4,720**	**4,960**	**4,250**	**5,000**	**4,140**	**3,000**	**4,510**	**5,680**	**5,990**	**7,710**	**5,500**
Manganese	0.275	350*	**863**	**597**	**1,040**	**1,120**	**1,050**	**978**	**964**	**927**	**1,050**	**905**	**1,140**	**1,080**	**956**	**954**
Mercury	0.05	2.3*	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Nickel	12.6	130	**28.3**	LT	**29.9**	**30.5**	**27.0**	**25.6**	**29.5**	**25.7**	LT	**29.2**	**30.8**	**30.5**	**27.9**	**48.6**
Potassium	37.5	-	**1,530**	**891**	**1,930**	**2,220**	**1,460**	**1,160**	**1,290**	**998**	**1,230**	**1,240**	**1,690**	**1,420**	**1,390**	**1,130**
Selenium	0.25	5	NRQ	LT	NRQ	NRQ	NRQ	NRQ	NRQ	LT	NRQ	LT	NRQ	LT	NRQ	LT
Silver	2.5	34	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT	LT
Sodium	150	-	**364**	**378**	**435**	**461**	**484**	**495**	**443**	**371**	**354**	**412**	**459**	**462**	**492**	**627**
Thallium	31.3	0.7	NRQ	LT	NRQ	NRQ	NRQ	NRQ	NRQ	LT	NRQ	LT	NRQ	LT	NRQ	LT
Vanadium	13	39*	NRQ	**46.1**	NRQ	NRQ	NRQ	NRQ	NRQ	**48.7**	NRQ	**51.2**	NRQ	**48**	NRQ	**49.4**
Zinc	30.2	2,300*	**137**	**72.9**	**109**	**164**	**102**	**92.5**	**107**	**87.5**	**118**	**91.9**	**110**	**109**	**112**	**86.1**

Notes:

Bold = Detected concentration

Gray highlight = A detected concentration above the selected screening level

Samples ending in 'A' were collected from a depth interval of 0-1 ft.

Samples ending in 'B' were collected from a depth interval of 1-2 ft.

LT = Less than certified reporting limit

mg/kg = milligrams per kilogram

NR = Not reported

NRQ = Analysis not requested for this sample

* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-3
1991 USATHAMA Soil PCB Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	**SS55A**
		Sample Interval (ft)>>	**0-1**
PCBs (mg/kg)	**Reporting Limit**	**TSCA Threshold**	
Aroclor 1260	33	1	**18,200**

Notes:
Bold = Detected concentration
PCBs = polychlorinated biphenyls
mg/kg = milligrams per kilogram
TSCA = Toxic Substances Control Act

TABLE 2-4
1991 USATHAMA Soil TCL SVOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SS41A	SS44B	SS46B	SS47B	SS48B	SS51B	SS52B	SS53B	SS54B
		Sample Interval (ft)>>	0–1	1–2	1–2	1–2	1–2	1–2	1–2	1–2	1–2
SVOCs (µg/kg)	**Reporting Limits**	**Screening Levels (0-10')**									
Anthracene	30	2,200,000*	LT	LT	LT	NRQ	LT	**100**	LT	**80**	LT
Benz[a]anthracene	170	887	LT	LT	LT	NRQ	LT	**290**	LT	**210**	**170**
Benz[b]fluoranthene	210	626	LT	LT	LT	NRQ	LT	**480**	LT	**390**	LT
Benzo[k]fluoranthene	70	1,500	LT	LT	LT	NRQ	LT	**150**	LT	**130**	**80**
Chrysene	120	15,000	LT	LT	LT	NRQ	**270**	**530**	**220**	**450**	**290**
Fluoranthene	70	230,000*	**110**	**110**	LT	LT	**340**	**910**	**290**	**760**	**450**
Phenanthrene	30	1,040	LT	LT	LT	NRQ	**140**	**600**	**130**	**470**	**160**
Pyrene	30	230,000*	**100**	**90**	LT	LT	**270**	**650**	**220**	**520**	**360**

Notes:
Bold = Detected concentration
Samples ending in 'A' were collected from a depth interval of 0-1 ft. Samples ending in 'B' were collected from a depth interval of 1-2 ft.
LT = Less than certified reporting limit
NRQ = Analysis not requested for this sample
SVOC = semi-volatile organic compound
TCL = Target Compound List
µg/kg = micrograms per kilogram
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
Samples were collected for explosives analyses, which resulted in no detections.

TABLE 2-5
1998 HARZA Soil RCRA Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

RCRA Metals (mg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	Test Method	Sample ID>>	NS02A	NS02B	NS03A	NS03B	NS05A	NS05B	NS07A	NS07B	NS08A	NS08B
				Sample Interval (ft)>>	0–1	1–2	0–1	1–2	0–1	1–2	0–1	1–2	0–1	1–2
Arsenic	12.3	12.3	SW6010/7000		**14.5**	**5**	**44**	**15.9**	**11.4**	**7.1**	**13.6**	**11.5**	**67.7**	**16.7**
Barium	1,600[b]	100,000	SW6010/7000		**141**	**209**	**123**	**109**	**109**	**79.3**	**130**	**141**	**144**	**153**
Cadmium	3.9[b]	56[b]	SW6010/7000		ND	ND	**0.74**	ND	**0.72**	**0.61**	ND	ND	ND	ND
Chromium	38	500	SW6010/7000		**19.8**	**15.9**	**21.5**	**17.4**	**20**	**22.5**	**16**	**14.1**	**16.6**	**16.9**
Lead	400	800	SW6010/7000		**48.8**	**51.4**	**5,840**	**87.3**	**102**	**185**	**20.5**	**32.3**	**56.6**	**32.6**
Mercury	2.3[b]	34[b]	SW6010/7000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	5	570[b]	SW6010/7000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	34	570[b]	SW6010/7000		ND	ND	**1.3**	**0.72**	**23.2**	**82.6**	ND	ND	ND	ND

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
Samples ending in 'A' were collected from a depth interval of 0-1 ft.
Samples ending in 'B' were collected from a depth interval of 1-2 ft.
mg/kg = milligrams per kilogram
ND = Chemical not detected
RCRA = Resource Conservation and Recovery
NS10, NS15, SN16, and NS17 are sediment
NS14A = Sample collected at 6-8' bgs
NS14B = Sample collected at 16-18' bgs
[a] Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-5
1998 HARZA Soil RCRA Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

RCRA Metals (mg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	Test Method	Sample ID>>	NS09A	NS09B	NS11A	NS11B	NS12A	NS12B	NS13A	NS13B	NS14A	NS14B
				Sample Interval (ft)>>	0–1	1–2	0–1	1–2	0–1	1–2	0–1	1–2	6–8	16–18
Arsenic	12.3	12.3	SW6010/7000		**5.3**	**7.5**	**10.1**	**7.8**	**9.9**	**7.4**	**11.4**	**6.3**	**7.8**	**7.3**
Barium	1,600[b]	100,000	SW6010/7000		**148**	**128**	**196**	**130**	**178**	**152**	**723**	**179**	**137**	**86.4**
Cadmium	3.9[b]	56[b]	SW6010/7000		ND	ND	**2.1**	ND	**0.97**	ND	**1.8**	ND	ND	ND
Chromium	38	500	SW6010/7000		**18.3**	**20.3**	**18.6**	**15.8**	**15.2**	**13.2**	**22.1**	**16.4**	**14.7**	**12.8**
Lead	400	800	SW6010/7000		**40.5**	**17.4**	**335**	**15.2**	**88.7**	**30.3**	**206**	**27.7**	**13.7**	**7.3**
Mercury	2.3[b]	34[b]	SW6010/7000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	5	570[b]	SW6010/7000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	34	570[b]	SW6010/7000		**0.65**	**0.67**	**0.76**	ND	**0.7**	ND	**0.68**	ND	ND	**0.69**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
Samples ending in 'A' were collected from a depth interval of 0-1 ft.
Samples ending in 'B' were collected from a depth interval of 1-2 ft.
mg/kg = milligrams per kilogram
ND = Chemical not detected
RCRA = Resource Conservation and Recovery
NS10, NS15, SN16, and NS17 are sediment
NS14A = Sample collected at 6-8' bgs
NS14B = Sample collected at 16-18' bgs
[a] Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-6
1998 HARZA Soil TCL SVOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	NS02B	NS03A	NS03B	NS05B	NS07A	NS07B	NS08A	NS08B
	Screening Levels	Sample Interval (ft)>>	1-2	0-1	1-2	1-2	0-1	1-2	0-1	1-2
TCL SVOCs (µg/kg)	(0-10')	Test Method								
Benzo(b)flouranthene	2,300	SW8270B	**134**	**161**	**104**	ND	**392**	**117**	**172**	**255**
Benzo(k)flouranthene	23,000	SW8270B	**105**	**137**	**79.2**	ND	**310**	ND	**92**	**180**
Benzo(a)pyrene	230	SW8270B	**107**	**130**	**89.2**	**65.9**	**301**	**90.9**	**124**	**212**
Indeno(1,2,3-cd)pyrene	2,300	SW8270B	**64.2**	**69.4**	ND	ND	**143**	ND	ND	ND
Benzo(g,h,i)perylene	478	SW8270B	ND	ND	ND	ND	**137**	ND	ND	**105**

Notes:
Reporting limits were not included in the in the 1998 *Site Investigation Report* (HARZA 1998).
Bold = Detected concentration
Samples ending in 'A' were collected from a depth interval of 0-1 ft. Samples ending in 'B' were collected from a depth interval of 1-2 ft.
ND = Not detected above the laboratory reporting limit
SVOC = Semivolatile organic compound
TCL = Target Compound List
µg/kg = micrograms per kilogram
Samples were collected for VOCs and explosives. RDX and HMX were detected at NS03A and NS03B.

TABLE 2-7
2001 TapanAm Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Metals (mg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	Test Method	Sample ID>>	SS-218A-1	SS-218A-2	SS-218C-1	SS-218A-3	SS-218B-1	SS-218B-2	SS-218C-2	SS-218C-3	SS-219A-1	SS-219A-2	SS-219A-3	SS-219B	SS-219C	SS-219D-1
				Sample Interval (ft)>>	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1
Aluminum	7,700*	100,000	SW6010B		**8,148**	**6,133**	**6,987**	**8,982**	**7,570**	**7,756**	**8,492**	**7,972**	**9,152**	**8,808 J**	**8,967 J**	**8,438**	**9,780**	**8,885**
Antimony	3.1*	45*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.59 J**	ND	**6.9**	ND	ND
Arsenic	12.3	12.3	SW6010B		**8.25**	**6.23**	**6.65**	**6.71**	ND	ND	ND	ND	ND	**6.67 J**	**4.93**	**108**	**68.8**	ND
Barium	1,600*	100,000	SW6010B		**205**	**128**	**107**	**184**	**182**	**178**	**215**	**193**	**0.0**	**149**	**129**	**135**	**125**	**157**
Beryllium	16*	220*	SW6010B		**0.592**	**0.511 J**	**0.428 J**	**0.526 J**	**0.501 J**	**0.467 J**	**0.523 J**	**0.471 J**	**0.538**	**0.517 J**	**0.528 J**	**0.531**	**0.558**	**0.556**
Cadmium	3.9*	56*	SW6010B		**1.28**	**3.29**	**0.851**	**1.52**	**1.96**	**1.16**	**1.65**	**0.834**	**0.701**	**0.493 J**	**0.409 J**	**1.22**	**0.721**	**0.592**
Calcium	-	-	SW6010B		**18,438**	**5,180**	**28,032**	**3,603**	**5,945**	**4,348**	**14,555**	**3,590**	**4,691**	**5,166**	**3,519**	**3,991**	**3,979**	**3,412**
Chromium	38	500	SW6010B		**14.5**	**28.5**	**12.1**	**13.7**	**17.4**	**19.2**	**21.2**	**11.8**	**15.8**	**14.2**	**15**	**14.8**	**15.5**	**15.6**
Cobalt	900	2,100	SW6010B		**8.78**	**8.4**	**6.34**	**9.82**	**8.73**	**8.44**	**9.48**	**8.71**	**8.54**	**8.54**	**8.12**	**10.2**	**8.5**	**9.28**
Copper	290*	4,200*	SW6010B		**59.6**	**2,565**	**29.1**	**62.9**	**143**	**35.6**	**107**	**36.4**	**27.1**	**21.1**	**17.4**	**24.5**	**18.8**	**21.1**
Iron	5,500*	100,000	SW6010B		**16,703**	**11,494**	**11,678**	**16,445**	**15,232**	**15,068**	**17,530**	**15,446**	**16,282**	**16,790**	**15,617**	**15,861**	**16,173**	**16,681**
Lead	400	800	SW6010B		**151**	**2,724**	**86.7**	**154**	**299**	**165**	**445**	**74.1**	**83.2**	**35.1**	**27.7**	**363**	**33.1**	**43.6**
Magnesium	-	-	SW6010B		**5,925**	**1,799**	**12,698**	**2,520**	**2,978**	**2,615**	**5,076**	**2,608**	**2,608**	**3,500**	**2,149**	**2,204**	**2,162**	**2,427**
Manganese	350*	3,500*	SW6010B		**787**	**501**	**460**	**750**	**530**	**649**	**617**	**708**	**610**	**667**	**581**	**662**	**600**	**682**
Mercury	2.3*	34*	SW7470A		ND	ND	ND	ND	**0.068 J**	ND	**0.06**	ND	**0.056 J**	**0.057 J**	ND	ND	ND	**0.054 J**
Nickel	130	2,300*	SW6010B		**17.8**	**15.2**	**12.9**	**19.9**	**18.0**	**18.0**	**18.7**	**19.5**	**18.2**	**19.2**	**16.8**	**18.3**	**16.8**	**18.7**
Potassium	-	-	SW6010B		**1,326**	**830**	**1,108**	**1,308**	**1,403**	**1,193**	**1,115**	**1,379**	**1,530**	**1,449**	**1,406**	**873**	**782**	**1,421**
Selenium	5	570*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	34	570*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	-	-	SW6010B		**66.2**	**52.3**	**106**	**57J**	**43 J**	**57 J**	**58.2**	**53.2**	**49.0**	**46.3 J**	**51.4 J**	**65.1 J**	**57.3 J**	**42.8J**
Thallium	0.7	79	SW6010B		**8.64 J**	ND	**2.74**	**7.67**	ND	**5.78 J**	ND	**1.94**	ND	ND	ND	ND	**2.64 J**	ND
Vanadium	39*	570*	SW6010B		**22.7**	**22.9**	**19.6**	**24.5**	**22.5**	**22.9**	**23.7**	**22.2**	**27.2**	**26.3**	**26.5**	**25.5**	**28.0**	**28.2**
Zinc	2,300*	100,000	SW6010B		**127**	**359**	**88.4**	**117**	**277**	**128**	**379**	**102**	**191**	**83.7**	**64.8**	**90.6**	**53.8**	**94.7**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
B = Blank detection
J = Reported value is estimated
mg/kg = milligrams per kilogram
NA = Sample interval was not available
ND = Chemical not detected
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[a] Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] Samples were collected offsite and not included in the human health risk assessment.
- = No screening level available.
Surface soil samples were also collected for explosives analysis; information provided in the 2001 Preliminary Assessment/Site Inspection Report indicated no detections in surface soil.

TABLE 2-7
2001 TapanAm Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Metals (mg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	Test Method	Sample ID>>	SS-219D-2	SS-219D-3	SS-219E	SS-219G-1	SS-219G-2	SS-219G-3	SS-219H	SS-219J-1	SS-BAK1[b]	SS-BAK2[b]	SS-BAK3[b]	SS-220-1	SS-220-2	SS-220-3
				Sample Interval (ft)>>	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1
Aluminum	7,700*	100,000	SW6010B		**8,095**	**7,516**	**8,960**	**8,925**	**8,431**	**11,990**	**8,799**	**8,488**	**5,114**	**5,126**	**7,947**	**6,333**	**8,148**	**7,896**
Antimony	3.1*	45*	SW6010B		ND	**2.14 J**	ND	ND	ND	ND	**2.2 J**	**5.73 J**	ND	ND	ND	ND	ND	ND
Arsenic	12.3	12.3	SW6010B		ND	ND	**23.5**	**5.1 J**	**7.3 J**	**6.63 J**	ND	**4.93 J**	**3.93 J**	**6.13**	ND	ND	ND	**8.08 J**
Barium	1,600*	100,000	SW6010B		**178**	**114**	**129**	**141**	**161**	**154**	**114**	**206**	**140**	**126**	**151**	**122**	**124**	**153**
Beryllium	16*	220*	SW6010B		**0.629**	**0.482**	**0.538**	**0.552 J**	**0.56**	**0.632**	**0.532**	**0.505 J**	**0.341**	**0.358 J**	**0.461**	**0.452 J**	**0.603**	**0.54**
Cadmium	3.9*	56*	SW6010B		**0.728**	**0.43 J**	**0.853**	**0.618**	**0.694**	ND	**0.314 J**	**1.72**	**0.728**	**0.655**	**0.483 J**	**1.03**	**0.859**	**1.32**
Calcium	-	-	SW6010B		**3,009**	**2,797**	**15,838 B**	**3,886**	**3,948**	**2,544**	**3,612**	**12,223**	**4,455 B**	**2,404 B**	**1,599 B**	**4,186 B**	**4,987 B**	**4,322 B**
Chromium	38	500	SW6010B		**13.7**	**13.2**	**16.2**	**15.3**	**14.9**	**17.0**	**16.0**	**18.6**	**9.08**	**9.87**	**10.7**	**11.7**	**20.8**	**14.9**
Cobalt	900	2,100	SW6010B		**9.64**	**7.3**	**8.78**	**8.52**	**9.01**	**10.2**	**8.73**	**8.95**	**8.21**	**7.7**	**8.93**	**8.23**	**8.23**	**9.42**
Copper	290*	4,200*	SW6010B		**20.3**	**14.5**	**34.3**	**23.9**	**192**	**17.6**	**19.9**	**129**	**12.4**	**13**	**11.2**	**21.8**	**18.8**	**37 J**
Iron	5,500*	100,000	SW6010B		**14,422**	**13,876**	**15,913**	**16,523**	**16,074**	**19,388**	**16,267**	**15,810**	**9,693**	**9,683**	**14,062**	**12,153**	**15,683**	**15,873**
Lead	400	800	SW6010B		**112**	**38.6**	**164.0**	**43.9**	**137**	**20**	**69.6**	**1,118**	**37.3**	**53.5**	**19.6**	**100**	**65**	**510 J**
Magnesium	-	-	SW6010B		**1,898**	**1,852**	**4,417**	**2,288**	**2,376**	**2,595**	**2,057**	**5,255**	**1,673**	**1,212**	**1,768**	**1,806**	**2,342**	**2,568**
Manganese	350*	3,500*	SW6010B		**763**	**562**	**617**	**601**	**683**	**708**	**516**	**639**	**1,128**	**1,132**	**791**	**676**	**591**	**622**
Mercury	2.3*	34*	SW7470A		ND	ND	**0.57 J**	ND	ND	ND	ND	**0.068 J**	ND	ND	ND	ND	ND	ND
Nickel	130	2,300*	SW6010B		**15.8**	**15.2**	**17.2**	**19.1**	**18.7**	**21.0**	**18.5**	**19.8**	**11.0**	**10.9**	**13.3**	**13.5**	**17.1**	**16.5**
Potassium	-	-	SW6010B		**980**	**1,136**	**998**	**1,194**	**1,337**	**1,144**	**693**	**1,165**	**981**	**816**	**751**	**1,112**	**1,115**	**927**
Selenium	5	570*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND	**4.52 J**	**3.98 J**	**6.42 J**	ND	**5.65 J**
Silver	34	570*	SW6010B		ND	ND	4	ND	ND	ND	ND	**0.9 J**	ND	ND	ND	ND	ND	ND
Sodium	-	-	SW6010B		**41.9 J**	**32.2 J**	**54.8 J**	**45 J**	**39.1 J**	**53.5 J**	**46.6 J**	**63.2 J**	**46.3 J**	**28.5 J**	**39.6 J**	**36J**	**49.6 J**	**60.1 J**
Thallium	0.7	79	SW6010B		ND	ND	**4.52 J**	ND	ND	ND	**2.18 J**	ND	**2.68 J**	ND	**2.14 J**	**2.36 J**	ND	ND
Vanadium	39*	570*	SW6010B		**24.4**	**22.7**	**25.2**	**27.9**	**26.3**	**31.4**	**25.9**	**22.7**	**16.8**	**16.8**	**21.9**	**20.4**	**27.4**	**24.7**
Zinc	2,300*	100,000	SW6010B		**106**	**64.8**	**110 B**	**88.8**	**86.7**	**56.7**	**81.7**	**343**	**61.3 B**	**64.2 J**	**20.1 B**	**106 B**	**86.5 B**	**213 B**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
B = Blank detection
J = Reported value is estimated
mg/kg = milligrams per kilogram
NA = Sample interval was not available
ND = Chemical not detected
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[a] Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] Samples were collected offsite and not included in the human health risk assessment.
- = No screening level available.
Surface soil samples were also collected for explosives analysis; information provided in the 2001 Preliminary Assessment/Site Inspection Report indicated no detections in surface soil.

TABLE 2-7
2001 TapanAm Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Metals (mg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	Test Method	Sample ID>>	SS-220-4	SS-227A-1	SS-227B-1	SS-227J-1	SS-227O-1	SS-227M-1	SS-228A-1	SS-228B-1	SS-228C-1	SS-228D-1	SS-228E-1	SS-228F-1	SS-228G-1	SS-228M-1
				Sample Interval (ft)>>	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1	0–1
Aluminum	7,700*	100,000	SW6010B		**8,681**	**8,259**	**7,519**	**7,052**	**6,292**	**8,300**	**7,960**	**6,794**	**6,105**	**7,580**	**5,500**	**6,563**	**6,840**	**7,845**
Antimony	3.1*	45*	SW6010B		ND	ND	**4.24 J**	ND	**14.1**	ND	**2.86 J**	**3.15 J**	**2.76 J**	ND	ND	ND	ND	ND
Arsenic	12.3	12.3	SW6010B		**4.38 J**	**11.7 J**	ND	**6.74 J**	**16.5**	**5.12 J**	**18.9**	**16.5**	**13.6**	ND	**13.7 J**	ND	ND	ND
Barium	1,600*	100,000	SW6010B		**145**	**87.9**	**96.9**	**123**	**191**	**133**	**132**	**120**	**98.3**	**99.9**	**101**	**80 J**	**102**	**122**
Beryllium	16*	220*	SW6010B		**0.563**	**0.615 J**	**0.537 J**	**0.476 J**	**0.492 J**	**0.535**	**0.509 J**	**0.484 J**	**0.461 J**	**0.453 J**	**0.416 J**	**0.425 J**	**0.457 J**	**0.507 J**
Cadmium	3.9*	56*	SW6010B		**0.873**	**0.898 J**	ND	**0.976**	**1.63**	**0.835**	ND	**1.03**	**0.916**	**1.07**	**1.09**	ND	**1.27**	ND
Calcium	-	-	SW6010B		**4,067 B**	**41,580**	**48,162**	**6,635**	**29,036**	**11,796**	**18,073**	**31,578**	**32,412**	**58,763**	**34,375**	**80,321**	**44,598**	**46,341**
Chromium	38	500	SW6010B		**18.9**	**16.8**	**15.2**	**13.7**	**20**	**15.7**	**13.5**	**13**	**14.5**	**13.8**	**10.6**	**12.2**	**14.1**	**15.2**
Cobalt	900	2,100	SW6010B		**8.95**	**9.68 J**	**7.08 J**	**8.31**	**7.95**	**9.05**	**7.27**	**7.45**	**6.94**	**7.2 J**	**7.49 J**	**6.61 J**	**7.11 J**	**8.62 J**
Copper	290*	4,200*	SW6010B		**38.0**	**30.2**	**18.1**	**25.1**	**77.2**	**34.4**	**22.7**	**25.4**	**26.2**	**24.7**	**30.8**	**18.9**	**29.5**	**20.5**
Iron	5,500*	100,000	SW6010B		**15,493**	**16,529**	**13,277**	**13,749**	**12,936**	**15,513**	**14,484**	**12,305**	**11,621**	**12,777**	**11,050**	**10,659**	**11,899**	**13,941**
Lead	400	800	SW6010B		**134**	**120**	**44.7**	**126**	**304.2**	**103**	**73.9**	**1,416**	**371**	**68.8**	**245**	**85.9**	**159**	**63.5**
Magnesium	-	-	SW6010B		**2,426**	**8,637**	**7,370**	**2,577**	**6,316**	**3,280**	**4,531**	**5,872**	**6,999**	**20,570**	**8,727**	**14,009**	**9,275**	**10,785**
Manganese	350*	3,500*	SW6010B		**665**	**611**	**483**	**558**	**509**	**619**	**551**	**502**	**472**	**461 B**	**602**	**463**	**440**	**512 B**
Mercury	2.3*	34*	SW7470A		**0.079 J**	ND	ND	ND	**0.054 J**	**0.075 J**	ND	ND	**0.055 J**	ND	**0.05 J**	ND	ND	ND
Nickel	130	2,300*	SW6010B		**18.2**	**19.9**	**15.5**	**15.8**	**15.6**	**18**	**16.9**	**16.9**	**15.9**	**14.8**	**14.0**	**15.2 J**	**15.5**	**14.6**
Potassium	-	-	SW6010B		**880**	**1,080**	**974 J**	**1,353**	**970**	**1,001**	**1,015**	**1,385**	**1,154**	**970 J**	**916**	**1,008 J**	**1,228**	**1,679**
Selenium	5	570*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	34	570*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	-	-	SW6010B		**43.6 J**	**66.6 J**	**65.1 J**	**54.2 J**	**54.1 J**	**56.6 J**	**63.2 J**	**59.2 J**	**53.6 J**	**216.0 J**	**53.2 J**	**74 J**	**77.9 J**	**94.8 J**
Thallium	0.7	79	SW6010B		**2.23 J**	ND	ND	**4.66 J**	ND	**5.07 J**	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	39*	570*	SW6010B		**27.1**	**24.3**	**21.9**	**22.2**	**20.3**	**25.1**	**22.7**	**19.9**	**18.8**	**19.4**	**15.9**	**16.4 J**	**20.0**	**23.3**
Zinc	2,300*	100,000	SW6010B		**117 B**	**1,305**	**77.6**	**193**	**323**	**116**	**182**	**177**	**285**	**337 B**	**215**	**111**	**243**	**152 B**

Notes:
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mg/kg = milligrams per kilogram
NA = Sample interval was not available
ND = Chemical not detected
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[a] Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] Samples were collected offsite and not included in the human health risk assessment.
- = No screening level available.
Surface soil samples were also collected for explosives analysis; information provided in the 2001 Preliminary Assessment/Site Inspection Report indicated no detections in surface soil.

TABLE 2-7
2001 TapanAm Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Metals (mg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	Test Method	Sample ID>>	SS-228WX-1	SS-228YZ-1	SS-236-1	SS-DPILE-1	PW12	PW13	SEW1	SEW2	SEW3
				Sample Interval (ft)>>	0–1	0–1	0–1	0–1	7–8	7–8	26.5–27.5	28–29	20.5–21
Aluminum	7,700*	100,000	SW6010B		**7,157**	**7,197**	**7,775**	**6,902**	**8,325**	**14,655**	**13,898**	**9,275**	**12,149**
Antimony	3.1*	45*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	12.3	12.3	SW6010B		ND	ND	**14.2**	**11.0 J**	**8.59 J**	ND	ND	**8.37 J**	**15.8**
Barium	1,600*	100,000	SW6010B		**127**	**108**	**136**	**141**	**93.6**	**168**	**61.7**	**67.1**	**301**
Beryllium	16*	220*	SW6010B		**0.463 J**	**0.477**	**0.581**	**0.509 J**	**0.364 J**	**0.986**	**0.603**	**0.373 J**	**0.564**
Cadmium	3.9*	56*	SW6010B		**1.49**	**3.17**	**0.779**	**0.693 J**	**0.529**	**0.709**	**0.321 J**	**0.363 J**	**0.737**
Calcium	-	-	SW6010B		**50,160**	**63,774**	**4,757**	**40,449**	**2,364**	**4,448**	**2,223**	**3,017**	**2,163**
Chromium	38	500	SW6010B		**16.1**	**19.7**	**15.2**	**13**	**13.2**	**20.3**	**20.9**	**16.9**	**16.6**
Cobalt	900	2,100	SW6010B		**7.44 J**	**8.49 J**	**11.6**	**8.61 J**	**5.13**	**12.6**	**3.15 J**	**11.9**	**13.1**
Copper	290*	4,200*	SW6010B		**50.5**	**150**	**22**	**23**	**9.03**	**17.4**	**8.77**	**10.5**	**18.5**
Iron	5,500*	100,000	SW6010B		**12,174**	**14,610**	**14,793**	**13,835**	**17,437**	**22,519**	**14,076**	**11,585**	**16,329**
Lead	400	800	SW6010B		**155**	**610**	**117**	**97.1**	**7.37 J**	**11**	**8.84 J**	**7.89 J**	**30.2**
Magnesium	-	-	SW6010B		**9,127**	**13,520**	**2,177**	**7,786**	**1,927**	**3,093**	**1,873**	**2,617**	**2,477**
Manganese	350*	3,500*	SW6010B		**529 B**	**518 B**	**546**	**624**	**306 B**	**695 B**	**47.6 B**	**147 B**	**952 B**
Mercury	2.3*	34*	SW7470A		**0.08 J**	**0.058 J**	**0.056 J**	ND	ND	ND	ND	ND	**0.073 J**
Nickel	130	2,300*	SW6010B		**13.7**	**16.7**	**18.3**	**15.4**	**11.1**	**24.4**	**10.6**	**12**	**19.3**
Potassium	-	-	SW6010B		**1,272**	**1,049 J**	**10,923**	**683 J**	**482**	**688**	**495**	**523**	**1,440**
Selenium	5	570*	SW6010B		ND	**12.4 J**	ND	ND	ND	ND	ND	ND	ND
Silver	34	570*	SW6010B		ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	-	-	SW6010B		**63.6 J**	**81.4 J**	**42.6 J**	**57.2 J**	**37.8 J**	**76.6 J**	**63.7 J**	**111 J**	**102 J**
Thallium	0.7	79	SW6010B		ND	ND	ND	ND	**3.62 J**	**5.19 J**	ND	**3.06 J**	**4.81 J**
Vanadium	39*	570*	SW6010B		**21.3**	**20.3**	**24.4**	**21.7**	**22**	**32.9**	**22.2**	**23.9**	**30.1**
Zinc	2,300*	100,000	SW6010B		**262 B**	**1,001 B**	**170**	**143**	**29.2 B**	**52.1 B**	**22.2 B**	**36.1 B**	**68.6 B**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
B = Blank detection
J = Reported value is estimated
mg/kg = milligrams per kilogram
NA = Sample interval was not available
ND = Chemical not detected
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[a] Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] Samples were collected offsite and not included in the human health risk assessment.
- = No screening level available.
Surface soil samples were also collected for explosives analysis; information provided in the 2001 Preliminary Assessment/Site Inspection Report indicated no detections in surface soil.

TABLE 2-8
2005 USACE Soil PCB Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SED-001	SS-001
		Sample Interval (ft)>>	NA	NA
PCBs (mg/kg)	**TSCA Threshold**	**Test Method**		
Aroclor 1260	1	8082	**569**	**1.44**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the screening level
mg/kg = milligrams per kilogram
NA = Sample interval was not available
PCB = polychlorinated biphenyl
TSCA = Toxic Substances Control Act

TABLE 2-9
2005 USACE Soil VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SB-002	SB-014	SB-016
		Sample Interval (ft)>>	NA	NA	NA
VOCs (µg/kg)	**Screening Levels (0-10')**	**Test Method**			
Carbon tetrachloride	70	SW8260B	NR	**4.3 J**	**3.0 J**
m-Xylene and p-Xylene	210,000	SW8260B	**2.6 J**	NR	NR

Notes:
Bold = Detected concentration
J = Reported value is estimated
NA = Sample interval was not available
NR = Not reported
VOC = volatile organic compound
µg/kg = micrograms per kilogram

TABLE 2-10
2005 USACE Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Metals (mg/kg)	Screening Levels (0-10')	Sample ID>> / Sample Interval (ft)>> / Test Method	SB-001 NA 6010B/6020A	SB-002 NA 6010B/6020A	SB-003 0-1 6010B/6020A	SB-005 NA 6010B/6020A	SB-006 0-1 6010B/6020A	SB-007 11-12 6010B/6020A	SB-008 NA 6010B/6020A	SB-009 NA 6010B/6020A	SB-010 NA 6010B/6020A	SB-010 0-1 6010B/6020A	SB-011 NA 6010B/6020A	SB-012 NA 6010B/6020A
Aluminum	7,700[a]	6010B/6020A	**6,030.6**	**5,840.1**	**6,755.4**	**7,129.1**	**7,674**	**8,651.6**	**7,104.3**	**7,027**	**6,837.1**	NR	**5,395.6**	**7,161.8**
Antimony	3.1[a]	6010B/6020A	**1.2 J**	NR	**5.3**	NR	NR	**3**	NR	NR	**1.5 J**	NR	NR	NR
Arsenic	12.3	6010B/6020A	**5.6**	**7.3**	**6.9**	**5.4**	**13.3**	**8.3**	**7.6**	**7.8**	**6.8**	NR	**6.1**	**7.0**
Barium	1,600[a]	6010B/6020A	**101.7**	**91.6**	**115.5**	**129.4**	**110.1**	**188.2**	**152**	**159.8**	**207.1**	NR	**151.1**	**149.8**
Beryllium	16[a]	6010B/6020A	**0.6**	**0.5 J**	**0.3 J**	**0.5 J**	**0.4 J**	**0.3 J**	**0.4 J**	**0.4 J**	**0.4 J**	NR	**0.3 J**	**0.3 J**
Cadmium	3.9[a]	6010B/6020A	**1.1 J**	NR	NR	NR	**0.9 J**	**1.5**	**0.5 J**	**0.7 J**	**0.9 J**	NR	**0.7 J**	**0.7 J**
Calcium	-	6010B/6020A	**54,916**	**46,903**	**52,444**	**5,234.3**	**7,023.6**	**10,240**	**4,741**	**4,449.5**	**10,181**	NR	**14,720**	**4,280.2**
Chromium	38	6010B/6020A	**13.6**	**11**	**11.5**	**13.8**	**14.1**	**23.7**	**11.9**	**11.6**	**16.1**	NR	**14.1**	**12.1**
Cobalt	900	6010B/6020A	**8.3**	**6.8**	**6.9**	**9.7**	**9.8**	**6.5**	**8.3**	**8.9**	**9.4**	NR	**7.3**	**8.6**
Copper	290[a]	6010B/6020A	**24.8**	**17.5**	**16.1**	**17.1**	**33.4**	**23.7**	**24.7**	**25.5**	**41.8**	NR	**21.0**	**23**
Iron	5,500[a]	6010B/6020A	**14,238**	**12,138**	**13,306**	**17,675**	**16,493**	**26,292**	**14,892**	**15,646**	**15,569**	NR	**12,114**	**15,438**
Lead	400	6010B/6020A	**107.2**	**45.8**	**28.3**	**48.8**	**112.5**	**195.7**	**45.5**	**43.6**	**85.3**	**983.0**	**165.7**	**43**
Magnesium	-	6010B/6020A	**7,598.9**	**6,949.9**	**15,724**	**1,987.2**	**2,574.1**	**2,249.9**	**2,336**	**2,137**	**3,023.8**	NR	**2,313.4**	**2,297.8**
Manganese	350[a]	6010B/6020A	**486.6**	**435.2**	**540.8**	**423.1**	**564.6**	**719.1**	**647.6**	**766.8**	**780.8**	NR	**570.2**	**672.3**
Mercury	2.3[a]	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nickel	130	6010B/6020A	**16.4**	**15.1**	**15.6**	**17.7**	**16.8**	**18.2**	**15.2**	**18.4**	**18.9**	NR	**12.7**	**16.9**
Potassium	-	6010B/6020A	**736.6 J**	**502.1 J**	**681 J**	**481.8 J**	**552.1**	**539.4 J**	**486.1**	**686.3**	**830**	NR	**684.3**	**921.9**
Selenium	5	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Silver	34	6010B/6020A	NR	**0.6 J**	NR	**0.6 J**	NR	**0.6 J**	NR	**0.6 J**	NR	NR	NR	NR
Sodium	-	6010B/6020A	**49.4**	**71.1**	**65.1**	**32.6**	**45.2**	**59.4**	**28**	**27.2**	**28.5**	NR	**20.5**	**20.5**
Thallium	0.7	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Vanadium	39[a]	6010B/6020A	**22.1**	**20.6**	**22.4**	**27.0**	**26.4**	**26.9**	**23.1**	**24.3**	**24.7**	NR	**21.6**	**24.2**
Zinc	2,300[a]	6010B/6020A	**418.7**	**64.9**	**48.9**	**42.8**	**154.2**	**150.3**	**61.3**	**81.8**	**91.3**	NR	**100.6**	**64.6**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level.
J = Reported value is estimated
mg/kg = milligrams per kilogram
NA = Sample interval was not available
NR = Not reported
SB-004 surface soil sample was not collected
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[b]This sample ID is most likely MW-106
Depths for SB samples reported were known
- = No screening level available.

TABLE 2-10
2005 USACE Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SB-013	SB-014	SB-015	SB-016	SB-017	SB-018	SB-019	SB-020	SB-020	SB-021	SB-022	SB-208[b]
	Screening Levels	Sample Interval (ft)>>	NA	NA	NA	NA	NA	NA	NA	0-1	8-9	NA	NA	NA
Target Analyte List Metals (mg/kg)	(0-10')	Test Method												
Aluminum	7,700[a]	6010B/6020A	**7,176.9**	**7,985.7**	**6,973.3**	**5,136.1**	**6,725.2**	**6,652.9**	**7,458.3**	**5,119.1**	NR	**7,012.3**	**7,621.8**	**7,321.8**
Antimony	3.1[a]	6010B/6020A	NR	NR	NR	**1.4 J**	NR	NR	NR	NR	NR	NR	NR	NR
Arsenic	12.3	6010B/6020A	**9.0**	**7.3**	**7.2**	**6.9**	**5.7**	**6**	**5.9**	**6**	NR	**7.4**	**4**	**5.8**
Barium	1,600[a]	6010B/6020A	**165.1**	**145.5**	**162.6**	**122.4**	**139.6**	**121.6**	**129.5**	**167.7**	NR	**137.6**	**99.6**	**112.4**
Beryllium	16[a]	6010B/6020A	**0.3 J**	**0.4 J**	**0.4 J**	**0.4 J**	**0.4 J**	**0.4 J**	**0.4 J**	**0.4 J**	NR	**0.3 J**	**0.3 J**	**0.4 J**
Cadmium	3.9[a]	6010B/6020A	**0.5 J**	**0.5 J**	**1.2**	**1.1 J**	**0.5 J**	**0.6 J**	**0.5 J**	**2.8**	NR	**0.6 J**	**0.3 J**	**0.4 J**
Calcium	-	6010B/6020A	**8,737.2**	**10,598**	**4,083.7**	**52,527**	**7,136.1**	**4,358.3**	**4,758.5**	**11,337**	NR	**2,528.9**	**2,431**	**11,086**
Chromium	38	6010B/6020A	**9.5**	**12.3**	**13.3**	**11.1**	**14.7**	**12.6**	**12.7**	**34.2**	NR	**10.6**	**12.6**	**13.0**
Cobalt	900	6010B/6020A	**8.5**	**8.5**	**8.5**	**6.7**	**6.9**	**7.3**	**7.7**	**7.7**	NR	**8.9**	**7.7**	**8.6**
Copper	290[a]	6010B/6020A	**16.5**	**16.7**	**115.3**	**35.1**	**16.6**	**21.3**	**14.5**	**126.6**	NR	**14.8**	**11.1**	**14.1**
Iron	5,500[a]	6010B/6020A	**15,569**	**15,918**	**15,390**	**13,155**	**14,153**	**13,762**	**14,235**	**14,092**	**23,197**	**15,605**	**13,488**	**16,010**
Lead	400	6010B/6020A	**33.5**	**24.9**	**125.1**	**108.8**	**42.4**	**52.6**	**17.8**	**983.3**	NR	**17.3**	**13.5**	**19**
Magnesium	-	6010B/6020A	**2,580.1**	**2,736.6**	**2,152.2**	**12,303**	**2,113.4**	**1,828.5**	**2,050.8**	**2,021.9**	NR	**2,143.7**	**2,043.1**	**2,335.3**
Manganese	350[a]	6010B/6020A	**828.8**	**592.3**	**652.5**	**588.6**	**596.5**	**539.4**	**672.7**	**560.3**	NR	**1,025.3**	**549.8**	**618.6**
Mercury	2.3[a]	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nickel	130	6010B/6020A	**18.1**	**16.7**	**15.4**	**15.4**	**14.6**	**14.4**	**15.4**	**15**	NR	**20.6**	**12.1**	**16.2**
Potassium	-	6010B/6020A	**986.7**	**819.7**	**748.8**	**737.4 J**	**851.9**	**890.2**	**463.6 J**	**1,525**	NR	**325.8 J**	**265.2 J**	**350.2 J**
Selenium	5	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Silver	34	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	**0.6 J**	NR	**0.5 J**	NR	NR
Sodium	-	6010B/6020A	**27.6**	**79.0**	**23.9**	**88.9**	**21.1**	**16.4**	**33.7**	**30.4**	NR	**49.8**	**24.1**	**25.2**
Thallium	0.7	6010B/6020A	NR	**0.3 J**	NR	NR	**0.3 J**	NR	NR	**0.4 J**	NR	**0.3 J**	NR	NR
Vanadium	39[a]	6010B/6020A	**22**	**24.9**	**24.6**	**18.4**	**24.1**	**25**	**25.4**	**21.1**	NR	**22.8**	**26.8**	**27.3**
Zinc	2,300[a]	6010B/6020A	**58.5**	**51.4**	**129.7**	**208.2**	**62.2**	**67**	**49.1**	**393.3**	NR	**45.9**	**33.7**	**37**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level.
J = Reported value is estimated
mg/kg = milligrams per kilogram
NA = Sample interval was not available
NR = Not reported
SB-004 surface soil sample was not collected
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[b]This sample ID is most likely MW-106
Depths for SB samples reported were known
- = No screening level available.

TABLE 2-10
2005 USACE Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Metals (mg/kg)	Screening Levels (0-10')	Sample ID>> / Sample Interval (ft)>> / Test Method	CSS-001 0-1	CSS-002 0-1	CSS-003 0-1	CSS-004 0-1	CSS-005 0-1	CSS-006 0-1	CSS-007 0-1	CSS-008 0-1	CSS-009 0-1	CSS-010 0-1	CSS-011 0-1	CSS-012 0-1
Aluminum	7,700[a]	6010B/6020A	**5,748.2**	**5,821**	**6,382.4**	**7,358.6**	**6,464.2**	**6,847.8**	**6,995.7**	**6,287.4**	**4,192.7**	**7,148.2**	**7,355.6**	**7,729.0**
Antimony	3.1[a]	6010B/6020A	**1.2 J**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Arsenic	12.3	6010B/6020A	**5.9**	**6.3**	**4**	**7**	**6.2**	**5.5**	**6.2**	**5.7**	**5.8**	**6.8**	**6.7**	**7.5**
Barium	1,600[a]	6010B/6020A	**106.9**	**109.8**	**97.9**	**140.6**	**141**	**176.5**	**129.3**	**115.8**	**86.2**	**177.7**	**169.1**	**146.2**
Beryllium	16[a]	6010B/6020A	NR	**0.4 J**	NR	**0.3 J**	**0.3 J**	**0.3 J**	**0.4 J**	NR	NR	**0.5**	**0.5**	**0.4 J**
Cadmium	3.9[a]	6010B/6020A	**1.1 J**	**0.5**	**0.5 J**	**0.3 J**	**0.5 J**	**0.8 J**	**0.6 J**	**0.6 J**	**0.4 J**	**0.6 J**	**0.9 J**	**0.5 J**
Calcium	-	6010B/6020A	**48,984**	**30,669**	**49,170**	**7,994.7**	**13,723**	**10,753**	**8,807.4**	**48,589**	**10,646**	**7,405.5**	**9,460**	**3,434.9**
Chromium	38	6010B/6020A	**10**	**8.2**	**14.2**	**5.7**	**6.4**	**7.3**	**8**	**8.1**	**3.8**	**7.6**	**18.7**	**6.9**
Cobalt	900	6010B/6020A	**8.2**	**9.8**	**8.5**	**8.7**	**7.8**	**8.8**	**8.1**	**10.5**	**5.1**	**12.4**	**8.1**	**9.7**
Copper	290[a]	6010B/6020A	**43.6**	**17.2**	**20.4**	**20.7**	**20.6**	**38.7**	**23.6**	**23.8**	**12**	**22.8**	**410.2**	**16.7**
Iron	5,500[a]	6010B/6020A	**21,855**	**13,020**	**13,258**	**15,411**	**13,429**	**14,467**	**14,827**	**13,028**	**9,094.2**	**18,123.0**	**15,177.0**	**15,843**
Lead	400	6010B/6020A	**1,022.9**	**44.3**	**143.3**	**34.6**	**56.1**	**73.9**	**42.3**	**51.4**	**27.7**	**40.3**	**78**	**24.9**
Magnesium	-	6010B/6020A	**7,977.9**	**5,266.4**	**7,703.6**	**3,740.2**	**4,056.1**	**2,791.7**	**3,134.3**	**2,468.9**	**1,398.7**	**2,475.6**	**2,184.9**	**2,118.7**
Manganese	350[a]	6010B/6020A	**516.8**	**594.2**	**526.6**	**654.6**	**617.9**	**673.7**	**546.4**	**656.2**	**336.3**	**938.2**	**406.9**	**761.9**
Mercury	2.3[a]	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nickel	130	6010B/6020A	**19.7**	**14.7**	**17.8**	**18.1**	**15.6**	**17.6**	**16.9**	**14.1**	**9.9**	**19.6**	**16.2**	**19.2**
Potassium	-	6010B/6020A	**712.1 J**	**616.7**	**515.2 J**	**700.9**	**759.6**	**651.3**	**747.5**	**972.9 J**	**382.9 J**	**721.5**	**449.8**	**593.4**
Selenium	5	6010B/6020A	NR	NR	NR	**0.5 J**	**0.6 J**	**0.5 J**	**0.6 J**	**0.7 J**	**0.6 J**	**0.6 J**	**0.5 J**	NR
Silver	34	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sodium	-	6010B/6020A	**42.7**	**39.3**	**39.1**	**28.3**	**31.5**	**46.5**	**25.8**	**24.1 J**	**24.7**	**23.4**	**32.5**	**22.9**
Thallium	0.7	6010B/6020A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	**0.2**
Vanadium	39[a]	6010B/6020A	**22.5**	**23.4**	**23.5**	**24.1**	**22**	**22.3**	**23.9**	**22**	**13.9**	**29.1**	**25.8**	**25.9**
Zinc	2,300[a]	6010B/6020A	**272.4**	**92.9**	**73.3**	**66.1**	**93.4**	**249.7**	**84**	**111.5**	**53.3**	**72.4**	**102.8**	**67.8**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level.
J = Reported value is estimated
mg/kg = milligrams per kilogram
NA = Sample interval was not available
NR = Not reported
SB-004 surface soil sample was not collected
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[b]This sample ID is most likely MW-106
Depths for SB samples reported were known
- = No screening level available.

TABLE 2-10
2005 USACE Soil TAL Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Analyte List Metals (mg/kg)	Screening Levels (0-10')	Sample ID>> / Sample Interval (ft)>> / Test Method	CSS-013 0-1	CSS-014 0-1	CSS-015 0-1
Aluminum	7,700[a]	6010B/6020A	**9,733.4**	**5,510.8**	**7,440**
Antimony	3.1[a]	6010B/6020A	NR	**1.2 J**	NR
Arsenic	12.3	6010B/6020A	**8.3**	**10.3**	**13**
Barium	1,600[a]	6010B/6020A	**151.1**	**134.3**	**125.7**
Beryllium	16[a]	6010B/6020A	**0.5**	**0.3 J**	**0.4 J**
Cadmium	3.9[a]	6010B/6020A	**0.8 J**	**0.7 J**	**0.5 J**
Calcium	-	6010B/6020A	**3,651.3**	**5,044.8**	**5,552.7**
Chromium	38	6010B/6020A	**8.6**	**9.1**	**7.2**
Cobalt	900	6010B/6020A	**10.1**	**7.2**	**8.5**
Copper	290[a]	6010B/6020A	**64.5**	**28**	**20.9**
Iron	5,500[a]	6010B/6020A	**17,813**	**11,512**	**14,421**
Lead	400	6010B/6020A	**40**	**176.9**	**40.2**
Magnesium	-	6010B/6020A	**2,060.5**	**2,125.2**	**2,173.7**
Manganese	350[a]	6010B/6020A	**562.0**	**528.3**	**622.8**
Mercury	2.3[a]	6010B/6020A	NR	NR	NR
Nickel	130	6010B/6020A	**18.2**	**13.8**	**15.9**
Potassium	-	6010B/6020A	**480.2**	**454.5**	**530.1**
Selenium	5	6010B/6020A	**0.6 J**	**0.6 J**	**0.7 J**
Silver	34	6010B/6020A	NR	NR	NR
Sodium	-	6010B/6020A	**25.6**	**32.3**	**17.5**
Thallium	0.7	6010B/6020A	NR	NR	NR
Vanadium	39[a]	6010B/6020A	**30.5**	**19.7**	**25.5**
Zinc	2,300[a]	6010B/6020A	**87.5**	**110.6**	**56.4**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level.
J = Reported value is estimated
mg/kg = milligrams per kilogram
NA = Sample interval was not available
NR = Not reported
SB-004 surface soil sample was not collected
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[b]This sample ID is most likely MW-106
Depths for SB samples reported were known
- = No screening level available.

TABLE 2-11
2005 USACE Soil PAH Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SB-001	SB-002	SB-002	SB-003	SB-005	SB-006	SB-008	SB-009	SB-010	SB-011
		Sample Interval (ft)>>	NA	NA	3-4	NA	NA	NA	NA	NA	0-1	NA
PAHs (µg/kg)	**Screening Levels (0-10')**	**Test Method**										
Acenaphthene	370,000[a]	SW8270C SIM	**3.3 J**	**13.2**	NR	NR	**9.1**	**2.3 J**	**20.0 J**	**29.1**	**115.2**	**27.3**
Acenaphthylene	30.5	SW8270C SIM	**2.2 J**	**3.7 J**	NR	NR	NR	NR	NR	**9**	NR	NR
Anthracene	2,200,000[a]	SW8270C SIM	**11.4**	**2.4 J**	NR	**4.2 J**	**4.1 J**	**5.2 J**	**4.9 J**	**44.4**	**173.7**	**661.7**
Benzo(a)anthracene	887	SW8270C SIM	**80.1**	**24**	NR	**30.7**	**21.4**	**54.5**	**37.4**	**111.3**	**729.5**	**325.2**
Benzo(a)pyrene	735	SW8270C SIM	**75.7**	**19.8**	**121**	**29.5**	**19.7**	**48.5**	**32.1**	**80**	**505.3**	**264.1**
Benzo(b)fluoranthene	626	SW8270C SIM	**122.8**	**28.4**	NR	**46.7**	**27.8**	**80.2**	**55.7**	**129.8**	**818.6**	**469.7**
Benzo(g,h,i)perylene	478	SW8270C SIM	**65.8**	**15.5**	NR	**25.8**	**14.3**	**36.2**	**26.4**	**52.3**	**355.5**	**200.8**
Benzo(k)fluoranthene	1,500	SW8270C SIM	**37.5**	**9.61**	NR	**14.3**	**88.5**	**19.7**	**17.2**	**40.2**	**280**	**125.9**
Chrysene	15,000	SW8270C SIM	**90**	**18**	NR	**34.2**	**22**	**50.2**	**38.1**	**90.6**	**562**	**329.6**
Dibenz(a,h)anthracene	303	SW8270C SIM	**12.1**	**3.0 J**	NR	**4.8 J**	**3.0 J**	**7.4 J**	**5.1 J**	**11.4**	**81.1**	**41.1**
Fluoranthene	230,000[a]	SW8270C SIM	**172.4**	**37**	NR	**63.2**	**42.1**	**96**	**65.7**	**251.7**	**1,461.5**	**830**
Fluorene	260,000[a]	SW8270C SIM	**3.8 J**	**10.7**	NR	NR	**9.6**	NR	NR	**15.5**	**53.2**	**25.3**
Indeno(1,2,3-cd)pyrene	415	SW8270C SIM	**58.1**	**14.8**	NR	**22.3**	**13.1**	**31.3**	**23.3**	**46.2**	**338.7**	**177.9**
Naphthalene	12,000[a]	SW8270C SIM	**2.09 J**	**7.12 J**	NR	NR	NR	**2.4 J**	NR	**4.2 J**	**12 J**	**3.8 J**
Phenanthrene	1,040	SW8270C SIM	**65.2**	**13.2**	NR	**21.3**	**18.2**	**22.7**	**22.3**	**164**	**808.1**	**436.5**
Pyrene	230,000[a]	SW8270C SIM	**143.5**	**35.5**	NR	**54.2**	**40.9**	**79.1**	**57.5**	**199**	**1,239.6**	**604.5**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
J = Reported value is estimated
NA = Sample interval was not available
NR = Not reported
PAH = polycyclic aromatic hydrocarbon
µg/kg = micrograms per kilogram
Depths for SB samples reported were known
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-11
2005 USACE Soil PAH Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SB-012	SB-013	SB-014	SB-015	SB-016	SB-017	SB-017	SB-018	SB-019
		Sample Interval (ft)>>	NA	NA	NA	NA	NA	NA	3-4	NA	NA
PAHs (µg/kg)	**Screening Levels (0-10')**	**Test Method**									
Acenaphthene	370,000[a]	SW8270C SIM	NR	NR	**55.9**	**8.5 J**	**14.5**	**75.6**	NR	**12.1**	**3.2 J**
Acenaphthylene	30.5	SW8270C SIM	NR	NR	NR	NR	4.3 J	NR	NR	NR	**3.9 J**
Anthracene	2,200,000[a]	SW8270C SIM	**4.4 J**	ND	**150.2**	**13.1**	**26.9**	**111.9**	NR	**22.8**	**7.2 J**
Benzo(a)anthracene	887	SW8270C SIM	**76.1**	**5.8 J**	**522.1**	**77.2**	**205.2**	**363**	NR	**140.1**	**48.8**
Benzo(a)pyrene	735	SW8270C SIM	**50.7**	**3.9 J**	**345**	**64.3**	**187.8**	**261.7**	**131**	**109.2**	**43.8**
Benzo(b)fluoranthene	626	SW8270C SIM	**111.7**	**7.9 J**	**603.4**	**112.1**	**331.5**	**456.8**	NR	**192**	**77.3**
Benzo(g,h,i)perylene	478	SW8270C SIM	**48.1**	**3.9 J**	**238.2**	**50.5**	**153.8**	**166.2**	NR	**83.1**	**35**
Benzo(k)fluoranthene	1,500	SW8270C SIM	**27.3**	**2.1 J**	**187**	**33**	**95.1**	**104.1**	NR	**45.6**	**19.8**
Chrysene	15,000	SW8270C SIM	**70**	**5.3 J**	**481.1**	**86.3**	**245.8**	**304**	NR	**120.4**	**56.8**
Dibenz(a,h)anthracene	303	SW8270C SIM	**9.9**	NR	**54.5**	**10.5**	**32**	**37**	NR	**17**	**6.6 J**
Fluoranthene	230,000[a]	SW8270C SIM	**128.4**	**10.1**	**1,317.4**	**176.4**	**497.9**	**836.8**	NR	**273**	**105.8**
Fluorene	260,000[a]	SW8270C SIM	ND	ND	**61.3**	**5.5 J**	**9.4**	**38.3**	NR	**6.6 J**	**2 J**
Indeno(1,2,3-cd)pyrene	415	SW8270C SIM	**42.3**	**3.4 J**	**223.6**	**44.9**	**148.8**	**149.8**	NR	**69.6**	**32.7**
Naphthalene	12,000[a]	SW8270C SIM	NR	NR	**3.3 J**	**2.5 J**	**2.7 J**	**6 J**	NR	NR	**7.2 J**
Phenanthrene	1,040	SW8270C SIM	**29.8**	**4.9 J**	**823.3**	**86.3**	**190**	**492.9**	NR	**112.1**	**40**
Pyrene	230,000[a]	SW8270C SIM	**105.7**	**8.5**	**897.8**	**140.5**	**378.4**	**673**	NR	**228**	**92.6**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
J = Reported value is estimated
NA = Sample interval was not available
NR = Not reported
PAH = polycyclic aromatic hydrocarbon
µg/kg = micrograms per kilogram
Depths for SB samples reported were known
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-11
2005 USACE Soil PAH Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SB-019	SB-020	CSS-001	CSS-002	CSS-003	CSS-004	CSS-005	CSS-006	CSS-007
		Sample Interval (ft)>>	3-4	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
PAHs (µg/kg)	**Screening Levels (0-10')**	**Test Method**									
Acenaphthene	370,000[a]	SW8270C SIM	NR	**41,912.1**	NR	NR	NR	NR	**23.4**	**3.5 J**	**9.8**
Acenaphthylene	30.5	SW8270C SIM	NR	NR	NR	NR	NR	NR	**5.79**	NR	NR
Anthracene	2,200,000[a]	SW8270C SIM	NR	**54,777**	NR	NR	NR	NR	**69.4**	**10.9**	**28.5**
Benzo(a)anthracene	887	SW8270C SIM	NR	**245,704**	NR	NR	NR	NR	**201**	**73.1**	**220.4**
Benzo(a)pyrene	735	SW8270C SIM	**119**	**196,359**	NR	NR	NR	NR	**142.8**	**61.5**	**171.7**
Benzo(b)fluoranthene	626	SW8270C SIM	NR	**388,878**	NR	NR	NR	NR	**246.1**	**90.6**	**337.3**
Benzo(g,h,i)perylene	478	SW8270C SIM	NR	**136,295**	NR	NR	NR	NR	**112.5**	**88.4**	**156.6**
Benzo(k)fluoranthene	1,500	SW8270C SIM	NR	**104,945**	NR	NR	NR	NR	**396.7**	**19.1**	**85.9**
Chrysene	15,000	SW8270C SIM	NR	**328,483**	NR	NR	NR	NR	**150.4**	**67.1**	**189.4**
Dibenz(a,h)anthracene	303	SW8270C SIM	NR	**30,616**	NR	NR	NR	NR	**30.1**	**10.9**	**37.7**
Fluoranthene	230,000[a]	SW8270C SIM	NR	**797,026**	NR	NR	NR	NR	**470.8**	**172.2**	**510**
Fluorene	260,000[a]	SW8270C SIM	NR	**36,137**	NR	NR	NR	NR	**25**	**4.1**	**7.6 J**
Indeno(1,2,3-cd)pyrene	415	SW8270C SIM	NR	**131,387**	NR	NR	NR	NR	**129.1**	**51.8**	**177.7**
Naphthalene	12,000[a]	SW8270C SIM	NR	**21,848 J**	NR	NR	NR	NR	**6.3 J**	NR	NR
Phenanthrene	1,040	SW8270C SIM	NR	**632**	NR	NR	NR	NR	**296.5**	**65.3**	**152.9**
Pyrene	230,000[a]	SW8270C SIM	NR	**703,713**	NR	NR	NR	NR	**320.8**	**110.8**	**308.4**

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
J = Reported value is estimated
NA = Sample interval was not available
NR = Not reported
PAH = polycyclic aromatic hydrocarbon
µg/kg = micrograms per kilogram
Depths for SB samples reported were known
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-11
2005 USACE Soil PAH Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	CSS-008	CSS-009	CSS-010	CSS-011	CSS-012	CSS-013	CSS-014	CSS-015
		Sample Interval (ft)>>	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
PAHs (µg/kg)	**Screening Levels (0-10')**	**Test Method**								
Acenaphthene	370,000[a]	SW8270C SIM	**8.6**	**59.1**	**14.7**	**17.8**	**10.4**	**6.2 J**	NR	NR
Acenaphthylene	30.5	SW8270C SIM	NR	NR	NR	NR	NR	NR	NR	NR
Anthracene	2,200,000[a]	SW8270C SIM	**288.3**	**125.1**	**43.1**	**35,530**	**30.1**	**11**	NR	NR
Benzo(a)anthracene	887	SW8270C SIM	**215.2**	**551.5**	**232.4**	**108.9**	**118.7**	**59**	NR	NR
Benzo(a)pyrene	735	SW8270C SIM	**164.6**	**434.3**	**169.3**	**82.3**	**78.2**	**47.2**	NR	NR
Benzo(b)fluoranthene	626	SW8270C SIM	**325.2**	**766.9**	**387.9**	**171.3**	**17.2**	**93.5**	NR	NR
Benzo(g,h,i)perylene	478	SW8270C SIM	**152.3**	**338.8**	**152.9**	**85.7**	**61.8**	**44**	NR	NR
Benzo(k)fluoranthene	1,500	SW8270C SIM	**84.2**	**185.7**	**57.2**	**27.2**	**24.5**	**24.3**	NR	NR
Chrysene	15,000	SW8270C SIM	**187.1**	**577.6**	**209.4**	**89.2**	**89.5**	**51.6**	NR	NR
Dibenz(a,h)anthracene	303	SW8270C SIM	**35.7**	**69.3**	**40.1**	**26.7**	**25.6**	**22.9**	NR	NR
Fluoranthene	230,000[a]	SW8270C SIM	**520.4**	**1,590**	**611.8**	**266.0**	**248.9**	**139.4**	NR	NR
Fluorene	260,000[a]	SW8270C SIM	**8**	**60.2**	**14.2**	**12.8**	**10.7**	**3.4**	NR	NR
Indeno(1,2,3-cd)pyrene	415	SW8270C SIM	**176.6**	**314.4**	**168.3**	**79.3**	**68.2**	**48.3**	NR	NR
Naphthalene	12,000[a]	SW8270C SIM	NR	**14.5 J**	NR	**3.1 J**	**3.2 J**	NR	NR	NR
Phenanthrene	1,040	SW8270C SIM	**159.6**	**922.1**	**260.4**	**142.2**	**135.9**	**53.8**	NR	NR
Pyrene	230,000[a]	SW8270C SIM	**305.3**	**1,039.6**	**358.2**	**173.5**	**168**	**88.9**	NR	NR

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
J = Reported value is estimated
NA = Sample interval was not available
NR = Not reported
PAH = polycyclic aromatic hydrocarbon
µg/kg = micrograms per kilogram
Depths for SB samples reported were known
[a]MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

TABLE 2-12
2007 USACE Kansas City District Soil VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

VOCs (µg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	Test Method	Sample ID>>	SB-023	SB-023	SB-023	SB-023	SB-023	SB-023	SB-024	SB-024	SB-024	SB-024	SB-025	SB-025	SB-025	SB-025	SB-026	SB-026
				Sample Interval (ft)>>	1.7–2.2	5–6	10–11	16–17	21–22	25–26	0.5–1	5–6	16–17	21–22	0.5–1	5–6	14–15	21–22	0.5–1	5–6
n-Butylbenzene	14,000[b]	240,000[b]	SW8260B		<6.0	<6.4	<6.5	<2.2 JB	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
sec -Butylbenzene	11,000[b]	220,000[b]	SW8260B		<6.0	<6.4	<6.5	**1.3 J**	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Carbon tetrachloride	70	580	SW8260B		<6.0	<6.4	**200.0**	**21.0**	**13.0**	**3.5 J**	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Chloroform	250	580	SW8260B		<6.0	<6.4	**2.2 J**	**.68 J**	**0.73 J**	<5.8	<6.0	<6.4	**0.47 J**	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,2-Dichlorobenzene	17,000	370,000	SW8260B		<6.0	<6.4	<6.5	<6.2	<5.9	<5.8	**5.5 J**	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,3-Dichlorobenzene	6,900[b]	14,000[v]	SW8260B		<6.0	<6.4	<6.5	<6.2 J	<5.9	<5.8	**0.78 J**	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,1-Dichloroethene	60	47,000[b]	SW8260B		**0.86 J**	<6.4	**2.2 J**	<6.2	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,2-Dichloroethane	20	840	SW8260B		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
cis -1,2-Dichloroethene	400	16,000[b]	SW8260B		**700.0**	**120.0**	**52.0**	**11.0**	**16.0**	**6.6**	**32.0**	**500.0**	**140.0**	**11.0**	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
trans -1,2-Dichloroethene	700	20,000[b]	SW8260B		**36.0**	**8.5**	**0.4 J**	<6.2	<5.9	<5.8	**1.6 J**	**16.0**	**0.54 J**	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Ethylbenzene	13,000	230,000	SW8260B		<6.0	<6.4	**19.0**	**120.0**	**7.8**	**3.0 J**	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Hexachlorobutadiene	2,000	2,500	SW8260B		<6.0 J	<6.4 J	<6.5 J	**8.6**	<5.9 J	<5.8 J	<6.0 J	<6.4 J	<6.3 J	<6.1 J	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Isopropylbenzene	37,000	58,000[b]	SW8260B		<6.0	<6.4	<6.5	**0.78 J**	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
4-Isopropyltoluene (p-isopropylte)	-	-	SW8260B		<6.0	<6.4	**1.7 J**	**8.8 J**	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Naphthalene	12,000[b]	21,000[b]	SW8260B		<6.0	<6.4	<6.5 J	<1.8 JB	<5.9	<5.8 J	<6.0 J	<6.4 J	<6.3 J	<6.1 J	<1.2 JBU	<6.3	<6.5	<6.0	<1.7 JBU	<6.5
1,1,1,2-Tetrachloroethane	3,000	7,600	SW8260B		<6.0	<6.4	**140.0**	**120.0**	**18.0**	**13.0**	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,1,2,2-Tetrachloroethane	3	970	SW8260B		<6.0	<6.4	<6.5	<6.2	<5.9	**1.2 J**	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Tetrachloroethene	60	1,700	SW8260B		**130.0 J**	**4,900.0**	**180,000.0 J**	**110,000.0 J**	**27,000.0**	**3,200,000.0 J**	**280.0 J**	**19.0**	**3,500.0**	**1,100.0**	**1.2 J**	<6.3	**6.1 J**	<6.0	**1.2 J**	**0.46 J**
Toluene	12,000	520,000	SW8260B		<6.0	<6.4	**7.3**	**4.6 J**	<5.9	<5.8	**0.66 J**	<6.4	<6.3	<6.1	**0.68 J**	<6.3	<6.5	<6.0	<6.5	<6.5
1,2,4-Trichlorobenzene	5,000	26,000[b]	SW8260B		<6.0	<6.4	<6.5	<6.2 J	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,1,1-Trichloroethane	2,000	1,400,000	SW8260B		<6.0	<6.4	**1.2 J**	<6.2	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,1,2-Trichloroethane	20	2,100	SW8260B		<6.0	<6.4	**15**	**4.9 J**	**3.1 J**	**2.9 J**	<6.0	<6.4	**0.62 J**	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
Trichloroethene	43	100	SW8260B		**590.0**	**520.0**	**140.0**	**140.0**	**18**	**6.0**	<6.0	**130.0**	**61 J**	**9.3**	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
1,2,4-Trimethylbenzene	5,700	19,000[b]	SW8260B		<6.0	<6.4	<1.2 JBU	<5.1 JBU	<5.9	<5.8	<0.93 JBU	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<1.4 JBU	<6.5
1,3,5-Trimethylbenzene	2,100[b]	7,800[b]	SW8260B		<6.0	<6.4	<2.0 JBU	**7.7 J**	<5.9	<5.8	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
o-Xylene	210,000	280,000	SW8260B		<6.0	<6.4	**8.3**	**32**	**2.1 J**	**0.97 J**	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5
m-and-p-Xylene	210,000	210,000	SW8260B		<6.0	<6.4	**58**	**400**	**26**	**10**	<6.0	<6.4	<6.3	<6.1	<6.2	<6.3	<6.5	<6.0	<6.5	<6.5

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
< = Chemical not detected
B = Blank detection
D = Qualified at dilution
J = Estimated, assigned by laboratory
JBU = Not detected, "U" qualifier assigned
NR = Not reported
VOC = volatile organic compound
µg/kg = micrograms per kilogram
[a]Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
- = No screening level available.

TABLE 2-12
2007 USACE Kansas City District Soil VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

VOCs (µg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	SB-026 14–15	SB-027 0.5–1	SB-027 5–6	SB-027 15–16	SB-027 20–21	SB-028 0.5–1	SB-028 5–6	SB-028 15–16	SB-028 20–21	SB-029 0.5–1	SB-029 5–6	SB-029 15–16	SB-029 20–21	SB-030 1.3–1.8	SB-030 5–6	SB-030 15–16	SB-030 21–22	SB-031 1.3–1.8
n-Butylbenzene	14,000[b]	240,000[b]	<6.3	**2.5 J**	<6.5	<6.3	<6.4	<6.4 J	<6.5 J	<6.2 J	<6.3 J	<6.4 J	<6.5 J	<6.2 J	<6.1 J	NR	NR	NR	NR	NR
sec -Butylbenzene	11,000[b]	220,000[b]	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4 J	<6.5 J	<6.2 J	<6.3 J	<6.4 J	<6.5 J	<6.2 J	<6.1 J	NR	NR	NR	NR	NR
Carbon tetrachloride	70	580	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
Chloroform	250	580	<6.3	<6.2	<6.5	**3.0 J**	**0.6 J**	<6.4	<6.5	**2.2 J**	**1.2 J**	<6.4	<6.5	**2.2 J**	<6.1	NR	NR	NR	NR	NR
1,2-Dichlorobenzene	17,000	370,000	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
1,3-Dichlorobenzene	6,900[b]	14,000[v]	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4 J	<6.5 J	<6.2 J	<6.3 J	<6.4 J	<6.5 J	<6.2 J	<6.1 J	NR	NR	NR	NR	NR
1,1-Dichloroethene	60	47,000[b]	<6.3	<6.2	<6.5	**1.1 J**	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
1,2-Dichloroethane	20	840	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	<6.2	**2.6 J**	**12.0**	**130.0**	<6.1
cis -1,2-Dichloroethene	400	16,000[b]	<6.3	**0.7 J**	**14**	**18**	**3.6 J**	**86 J**	**50.0**	**160.0**	**63.0**	**0.67 J**	**58.0**	**100.0**	**140.0**	**0.80 J**	**19.0 J**	**8.4 J**	**0.95 J**	**53.0 J**
trans -1,2-Dichloroethene	700	20,000[b]	<6.3	<6.2	**1.6 J**	<6.3	<6.4	**1.9 J**	**1.4 J**	**1.3 J**	**0.41 J**	<6.4	**0.62 J**	**1.7 J**	**2.0 J**	<6.2 J	**1.0 J**	<6.1 J	<6.2 J	**13 J**
Ethylbenzene	13,000	230,000	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
Hexachlorobutadiene	2,000	2,500	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
Isopropylbenzene	37,000	58,000[b]	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
4-Isopropyltoluene (p-isopropylte)	-	-	<6.3	**1.5 J**	<6.5	<6.3	<6.4	<6.4 J	<6.5 J	<6.2 J	<6.3 J	<6.4 J	<6.5 J	<6.2 J	<6.1 J	NR	NR	NR	NR	NR
Naphthalene	12,000[b]	21,000[b]	<6.3	**8.7**	<6.5	<6.3	<6.4	<3.4 J	<6.5 J	<6.2 J	<6.3 J	<6.4 J	<1.4 JBU	<6.2 J	<6.1 J	NR	NR	NR	NR	NR
1,1,1,2-Tetrachloroethane	3,000	7,600	<6.3	<6.2	<6.5	**6 J**	<6.4	<6.4	<6.5	**4.5 J**	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
1,1,2,2-Tetrachloroethane	3	970	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
Tetrachloroethene	60	1,700	<6.3	**100.0 J**	**320.0**	**8,000.0**	**2,900.0**	**6,400.0**	**780.0**	**3,500.0**	**2,300.0**	**17.0 J**	**48.0 J**	**550.0**	**610.0**	<6.2	**58.0**	**2,100.0 D**	**1,000.0 D**	<6.1
Toluene	12,000	520,000	<6.3	**1.0 J**	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
1,2,4-Trichlorobenzene	5,000	26,000[b]	<6.3	**2.1 J**	<6.5	<6.3	<6.4	<6.4 J	<6.5 J	<6.2 J	<6.3 J	<6.4 J	<6.5 J	<6.2 J	<6.1 J	NR	NR	NR	NR	NR
1,1,1-Trichloroethane	2,000	1,400,000	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	<6.2	<6.4	<6.1	<6.2	<6.1
1,1,2-Trichloroethane	20	2,100	<6.3	<6.2	<6.5	**1.7 J**	**0.8 J**	<6.4	<6.5	**0.88 J**	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
Trichloroethene	43	100	<6.3	**7.0**	**52.0**	**110.0**	**20.0**	**810.0**	**43.0**	**110.0**	**54.0**	**2.2 J**	**31.0**	**59.0**	**66.0**	**0.65 J**	**42.0 J**	**14.0 J**	**11.0 J**	**41.0 J**
1,2,4-Trimethylbenzene	5,700	19,000[b]	<6.3	**11.0**	<6.5	<0.84 JBU	<6.4	<1.9 JBU	<6.5	<6.2	<6.3	<6.4	<2.0 JBU	<0.71 JBU	<6.1	NR	NR	NR	NR	NR
1,3,5-Trimethylbenzene	2,100[b]	7,800[b]	<6.3	**5.1 J**	**0.89 J**	<6.3	<6.4	<6.4 J	<6.5 J	<6.2 J	<6.3 J	<6.4 J	<0.83 JBU	<6.2 J	<6.1 J	NR	NR	NR	NR	NR
o-Xylene	210,000	280,000	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR
m-and-p-Xylene	210,000	210,000	<6.3	<6.2	<6.5	<6.3	<6.4	<6.4	<6.5	<6.2	<6.3	<6.4	<6.5	<6.2	<6.1	NR	NR	NR	NR	NR

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
< = Chemical not detected
B = Blank detection
D = Qualified at dilution
J = Estimated, assigned by laboratory
JBU = Not detected, "U" qualifier assigned
NR = Not reported
VOC = volatile organic compound
µg/kg = micrograms per kilogram
[a]Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
- = No screening level available.

TABLE 2-12
2007 USACE Kansas City District Soil VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

VOCs (µg/kg)	Screening Levels (0-10')	Screening Levels[a] (>10')	SB-031 5–6	SB-031 14–15	SB-031 21–22	SB-032 1.1–1.6	SB-032 5–6	SB-032 15–16	SB-032 21–22	SB-033 0.5–1	SB-033 5–6	SB-033 13–14	SB-033 19–20	SB-033 23–24	SB-034 0.5–1	SB-034 5–6	SB-034 14–15	SB-034 20–21
n-Butylbenzene	14,000[b]	240,000[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
sec -Butylbenzene	11,000[b]	220,000[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbon tetrachloride	70	580	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chloroform	250	580	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,2-Dichlorobenzene	17,000	370,000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,3-Dichlorobenzene	6,900[b]	14,000[v]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,1-Dichloroethene	60	47,000[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,2-Dichloroethane	20	840	**7.1**	**49.0**	**3.9 J**	<6.3	**1.4 J**	**11.0**	<6.2	<6.3	<6.4	<6.2	<6.3	<6.2	<6.4	<6.5	<6.1	<6.1
cis -1,2-Dichloroethene	400	16,000[b]	**43.0 J**	<6.3 J	<6.1 J	<6.3 J	**3.9 J**	<6.4 J	<6.2	<6.3	**7.6**	**190.0 JD**	**340.0 JD**	**280.0 J**	**8.7**	**1.7 J**	**17.0**	**7.3**
trans -1,2-Dichloroethene	700	20,000[b]	**6.8 J**	<6.3 J	<6.1 J	<6.3 J	<6.7 J	<6.4 J	<6.2	<6.3	<6.4	**3.9 J**	**6.8**	**3.3 J**	<6.4	<6.5	**0.45 J**	<6.1
Ethylbenzene	13,000	230,000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hexachlorobutadiene	2,000	2,500	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Isopropylbenzene	37,000	58,000[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
4-Isopropyltoluene (p-isopropylte)	-	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Naphthalene	12,000[b]	21,000[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,1,1,2-Tetrachloroethane	3,000	7,600	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,1,2,2-Tetrachloroethane	3	970	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Tetrachloroethene	60	1,700	**920.0 D**	**460.0 D**	**4.1 J**	<6.3	<6.7	**10.0**	**0.40 J**	**11.0**	**11.0**	**1,100.0 D**	**1,500.0 D**	**890.0 J**	**52.0**	**28.0**	**1,000.0 D**	**380.0 D**
Toluene	12,000	520,000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,2,4-Trichlorobenzene	5,000	26,000[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,1,1-Trichloroethane	2,000	1,400,000	<6.3	<6.3	<6.1	<6.3	<6.7	<6.4	<6.2	<6.3	<6.4	<6.2	<6.3	<6.2	<6.4	<6.5	**0.94 J**	**0.53 J**
1,1,2-Trichloroethane	20	2,100	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Trichloroethene	43	100	**180.0 J**	**16.0 J**	**1.2 J**	<6.3 J	**4.2 J**	**3.0 J**	<6.2	**1.1 J**	**6.5**	**120.0**	**180.0 JD**	**140.0**	**16.0**	**32.0**	**38.0**	**17.0**
1,2,4-Trimethylbenzene	5,700	19,000[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1,3,5-Trimethylbenzene	2,100[b]	7,800[b]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
o-Xylene	210,000	280,000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
m-and-p-Xylene	210,000	210,000	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Notes:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level
< = Chemical not detected
B = Blank detection
D = Qualified at dilution
J = Estimated, assigned by laboratory
JBU = Not detected, "U" qualifier assigned
NR = Not reported
VOC = volatile organic compound
µg/kg = micrograms per kilogram
[a]Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[b] MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
- = No screening level available.

TABLE 2-13
2008 RI Surface Soil TAL Metals and PAH Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

					Location>>	HA-01	HA-02	HA-03	HA-04	HA-05	HA-06	HA-07	HA-08	HA-09	HA-10	HA-11	HA-12
					Sample ID>>	HA-01-S-00	HA-02-S-00	HA-03-S-00	HA-04-S-00	HA-05-S-00	HA-06-S-00	HA-07-S-00	HA-08-S-00	HA-09-S-00	HA-10-S-00	HA-11-S-00	HA-12-S-00
					Sample Depth (ft)>>	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–0.25	0–2	0–2
					Sample Date>>	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008
Target Analyte List Metals	Units	Minimum Method Detection Limit	Minimum Reporting Limit	Screening Level (0-10')	Test Method												
Arsenic	mg/kg	0.3042	0.6084	12.3	SW6010B	**8.82**	**9.41**	**10**	**5.94**	**36.3**	**18.2**	**8.11**	**7.39**	**5.9**	**8.06**	**9.42**	**8.41**
Lead	mg/kg	0.1957	0.4598	400	SW6010B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons	Units			Screening Level (0-10')	Test Method												
1-Methylnaphthalene	µg/kg	34	196.6	--	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	µg/kg	28	196.6	--	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	µg/kg	28	196.6	370,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	µg/kg	32	196.6	30.5	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	µg/kg	32	196.6	2,200,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	µg/kg	26	196.6	887	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	µg/kg	22	196.6	735	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	µg/kg	33.2	196.6	626	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	µg/kg	23	196.6	478	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	µg/kg	27	196.6	1,500	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	µg/kg	25.1	196.6	15,000	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	µg/kg	29	196.6	303	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	µg/kg	21	196.6	230,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	µg/kg	31	196.6	260,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/kg	25.1	196.6	415	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	µg/kg	30	196.6	12,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	µg/kg	30	196.6	1,040	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	µg/kg	23	196.6	230,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note:
Bold type indicates a concentration above the sample quantification limit.
Gray highlight = A detected concentration above the selected screening level
Results reported as dry unit weight.
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
J = Reported value is estimated
NA = Not Analyzed
U = Not detected above the laboratory reporting limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram

TABLE 2-13
2008 RI Surface Soil TAL Metals and PAH Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

					Location>>	HA-13	HA-14	HA-15	HA-16	HA-17	HA-18	HA-19	HA-20	HA-21	HA-22
					Sample ID>>	HA-13-S-00	HA-14-S-00	HA-15-S-00	HA-16-S-00	HA-17-S-00	HA-18-S-00	HA-19-S-00	HA-20-S-00	HA-21-S-00	HA-22-S-00
					Sample Depth (ft)>>	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2
					Sample Date>>	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/14/2008	5/14/2008	5/14/2008	5/14/2008	5/14/2008	5/14/2008
Target Analyte List Metals	Units	Minimum Method Detection Limit	Minimum Reporting Limit	Screening Level (0-10')	Test Method										
Arsenic	mg/kg	0.3042	0.6084	12.3	SW6010B	**9.05**	**8.19**	**9.14**	**5.47**	NA	NA	NA	NA	NA	NA
Lead	mg/kg	0.1957	0.4598	400	SW6010B	NA	NA	NA	NA	NA	NA	NA	**54.8 J**	**31 J**	**65 J**
Polycyclic Aromatic Hydrocarbons	Units			Screening Level (0-10')	Test Method										
1-Methylnaphthalene	µg/kg	34	196.6	--	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	243 U
2-Methylnaphthalene	µg/kg	28	196.6	--	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	243 U
Acenaphthene	µg/kg	28	196.6	370,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	243 U
Acenaphthylene	µg/kg	32	196.6	30.5	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	243 U
Anthracene	µg/kg	32	196.6	2,200,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**103 J**
Benzo(a)anthracene	µg/kg	26	196.6	887	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**505**
Benzo(a)pyrene	µg/kg	22	196.6	735	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**475**
Benzo(b)fluoranthene	µg/kg	33.2	196.6	626	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**604**
Benzo(g,h,i)perylene	µg/kg	23	196.6	478	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**242 J**
Benzo(k)fluoranthene	µg/kg	27	196.6	1,500	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**238 J**
Chrysene	µg/kg	25.1	196.6	15,000	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**512**
Dibenz(a,h)anthracene	µg/kg	29	196.6	303	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**65.2 J**
Fluoranthene	µg/kg	21	196.6	230,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**1140**
Fluorene	µg/kg	31	196.6	260,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	243 U
Indeno(1,2,3-cd)pyrene	µg/kg	25.1	196.6	415	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**211 J**
Naphthalene	µg/kg	30	196.6	12,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	243 U
Phenanthrene	µg/kg	30	196.6	1,040	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**527**
Pyrene	µg/kg	23	196.6	230,000*	SW8270C	NA	NA	NA	NA	NA	NA	NA	NA	NA	**901**

Note:
Bold type indicates a concentration above the sample quantification limit.
Gray highlight = A detected concentration above the selected screening level
Results reported as dry unit weight.
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
J = Reported value is estimated
NA = Not Analyzed
U = Not detected above the laboratory reporting limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram

TABLE 2-14
2008 RI Surface Soil TCLP RCRA Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

					Location>>	HA-05	HA-06	HA-11	HA-13	HA-15	HA-17	HA-18	HA-19
					Sample ID>>	HA-05-S-00	HA-06-S-00	HA-11-S-00	HA-13-S-00	HA-15-S-00	HA-17-S-00	HA-18-S-00	HA-19-S-00
					Sample Depth (ft)>>	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2
					Sample Date>>	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/13/2008	5/14/2008	5/14/2008	5/14/2008
RCRA Metals	Units	Minimum Method Detection Limit	Minimum Reporting Limit	TCLP Limit	Test Method								
Arsenic	mg/L	0.03	0.1	5	SW6010B	**0.0598 J**	**0.0829 J**	**0.0992 J**	0.03 U	**0.0387 J**	0.043 U	0.043 U	**0.0524 J**
Barium	mg/L	0.0022	0.1	100	SW6010B	**1.33**	**1.29**	**1.59**	**1.54**	**1.08**	**1.28**	**1.22**	**1.04**
Cadmium	mg/L	0.0072	0.05	1	SW6010B	0.0072 U	0.0072 U	0.0072 U	0.0072 U	0.0072 U	0.0072 U	0.0072 U	0.0072 U
Chromium	mg/L	0.004	0.1	5	SW6010B	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	**0.0116 J**	**0.00851 J**
Lead	mg/L	0.037	0.15	5	SW6010B	**0.0382 J**	**0.0566 J**	0.0624 J	0.037 U	0.037 U	**0.0392 J**	0.037 U	0.037 U
Mercury	mg/L	0.00025	0.002	0.2	SW7470A	0.00025 R	0.00025 R	0.00025 R	0.00025 R	0.00025 R	0.00025 U	0.00025 U	0.00025 U
Selenium	mg/L	0.04	0.15	1	SW6010B	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Silver	mg/L	0.0051	0.1	5	SW6010B	0.0051 U	0.0051 U	0.0051 U	0.0051 U	0.0051 U	0.0051 U	0.0051 U	0.0051 U

Note:
Bold type indicates a concentration above the sample quantification limit.
NA = Not Analyzed
R = Compound may or may not be present.
RCRA = Resource Conservation and Recovery Act
TCLP = Toxicity Characteristic Leaching Procedure
U = Not detected above the laboratory reporting limit.
mg/kg = milligrams per kilogram

TABLE 2-15
Confirmation Soil TCL VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Compound List VOC	Units	Minimum Method Detection Limit	Minimum Reporting Limit	Screening Level (0-10')	Screening Levels[b] (>10')	Test Method	Location>>	CB-01	CB-01[c]	CB-02	CB-03	CB-04	CB-05[c]	CB-05[c]	CB-06	CB-07
							Sample ID>>	CB-01-S-30	Soil-2	CB-02-S-30	CB-03-S-8	CB-04-S-19	Soil-3	Soil-1	CB-06-S-21.5	CB-07-S-2
							Sample Depth (ft)>>	30-30.5	30-32	30-30.5	8-10	19-20	4-13	13-21	21.5-22.5	2-3
							Sample Date>>	5/21/2008	5/21/2008	5/21/2008	5/22/2008	5/22/2008	5/23/2008	5/23/2008	5/23/2008	5/29/2008
1,1,1,2-Tetrachloroethane	µg/kg	0.405	1.84	3,000	7,600	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,1,1-Trichloroethane	µg/kg	0.604	1.84	2,000	1,400,000	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,1,2,2-Tetrachloroethane	µg/kg	0.558	1.84	3	970	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 UJ	2.7 U
1,1,2-Trichloroethane	µg/kg	0.36	1.84	20	2,100	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,1-Dichloroethane	µg/kg	0.666	1.84	23,000	2,300,000	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,1-Dichloroethene	µg/kg	0.574	1.84	60	47,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,1-Dichloropropene	µg/kg	0.581	1.84	-	-	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,2,3-Trichlorobenzene	µg/kg	0.62	1.84	-	-	SW8260B	398 U	116 U	**1 J**	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,2,3-Trichloropropane	µg/kg	0.757	1.84	320	1,600	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,2,4-Trichlorobenzene	µg/kg	0.604	1.84	5,000	26,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,2,4-Trimethylbenzene	µg/kg	0.46	1.84	5,700	19,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,2-Dibromo-3-chloropropane	µg/kg	0.995	9.3	2.6	20	SW8260B	1,990 U	116 U	12.6 U	12.1 U	12 U	115 U	115 U	12 UJ	13.5 U
1,2-Dibromoethane(EDB)	µg/kg	0.39	1.84	28	70	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115U	2.4 U	2.7 U
1,2-Dichlorobenzene	µg/kg	0.39	1.84	17,000	370,000	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,2-Dichloroethane	µg/kg	0.444	1.84	20	840	SW8260B	398 U	116 U	2.5 U	2.4 U	**33**	115 U	115 U	2.4 U	2.7 U
1,2-Dichloropropane	µg/kg	0.444	1.84	30	850	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,3,5-Trimethylbenzene	µg/kg	0.497	1.84	2,100[a]	7,800[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,3-Dichlorobenzene	µg/kg	0.428	1.84	6,900[a]	14,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,3-Dichloropropane	µg/kg	0.38	1.84	11,000[a]	41,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
1,4-Dichlorobenzene	µg/kg	0.543	1.84	2000	8100	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
2,2-Dichloropropane	µg/kg	0.589	1.84	-	-	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
2-Butanone	µg/kg	0.77	9.3	3,200,000[a]	3,400,000[a]	SW8260B	1,990 U	1,160 U	12.6 U	12.1 U	12 U	1,150 U	1,150 U	12 UJ	**1.3 J**
2-Chlorotoluene	µg/kg	0.52	1.84	160,000[a]	510,000	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
2-Hexanone	µg/kg	0.995	9.3	-	-	SW8260B	1,990 U	NA	12.6 U	12.1 U	12 U	NA	NA	12 U	13.5 U
4-Chlorotoluene	µg/kg	0.428	1.84	-	-	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
4-Isopropyltoluene	µg/kg	0.46	1.84	-	-	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
4-Methyl-2-pentanone	µg/kg	1.3	9.3	-	-	SW8260B	1,990 U	NA	12.6 U	12.1 U	12 U	NA	NA	12 U	**2.4 J**
Acetone	µg/kg	4.74	9.3	16,000	6,000,000[a]	SW8260B	1,990 U	1,160 U	12.6 U	12.1 U	12 U	1,150 U	1,150 U	12 UJ	13.5
Acrolein	µg/kg	4.9	23	-	-	SW8260B	4,970 U	NA	31.4 U	30.3 U	30.1 U	NA	NA	30.1 UJ	33.8 U
Acrylonitrile	µg/kg	1.55	5.15	-	-	SW8260B	995 U	NA	6.3 U	6 U	6 U	NA	NA	6 U	6.8 U
Benzene	µg/kg	0.38	1.84	30	1,600	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Bromobenzene	µg/kg	0.428	1.84	7,300	12,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Bromochloromethane	µg/kg	0.842	1.84	-	-	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Bromodichloromethane	µg/kg	0.497	1.84	600	2,600	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Bromoform	µg/kg	1.3	4.6	800	240,000	SW8260B	995 U	116 U	6.3 U	6 U	6 U	115 U	115 U	6 U	6.8 U
Bromomethane	µg/kg	0.581	1.84	200	1,500	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 UJ	2.7 U
Carbon disulfide	µg/kg	0.352	1.84	32,000	720,000[a]	SW8260B	398 U	NA	2.5 U	2.4 U	2.4 U	NA	NA	2.4 U	2.7 U
Carbon tetrachloride	µg/kg	0.604	1.84	70	580	SW8260B	**27,300 J**	**6,670**	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Chlorobenzene	µg/kg	0.321	1.84	1,000	50,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Chloroethane	µg/kg	1.68	4.6	3,000	7,200	SW8260B	995 U	116 U	6.3 UJ	6 U	6 U	115 U	115 U	6 U	6.8 U
Chloroform	µg/kg	0.543	1.84	250	580	SW8260B	**669**	**268**	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Chloromethane	µg/kg	0.428	1.84	11,000[a]	17,000[a]	SW8260B	398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U

TABLE 2-15
Confirmation Soil TCL VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Target Compound List VOC	Units	Minimum Method Detection Limit	Minimum Reporting Limit	Screening Level (0-10')	Screening Levels[b] (>10')	Location>> / Sample ID>> / Sample Depth (ft)>> / Sample Date>> / Test Method	CB-01 CB-01-S-30 30-30.5 5/21/2008 SW8260B	CB-01[c] Soil-2 30-32 5/21/2008	CB-02 CB-02-S-30 30-30.5 5/21/2008	CB-03 CB-03-S-8 8-10 5/22/2008	CB-04 CB-04-S-19 19-20 5/22/2008	CB-05[c] Soil-3 4-13 5/23/2008	CB-05[c] Soil-1 13-21 5/23/2008	CB-06 CB-06-S-21.5 21.5-22.5 5/23/2008	CB-07 CB-07-S-2 2-3 5/29/2008
cis -1,2-Dichloroethene	µg/kg	0.918	1.84	400	16,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	**40 J**	**29.8 J**	2.4 U	2.7 U
cis -1,3-Dichloropropene	µg/kg	0.275	1.84	-	-		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Dibromochloromethane	µg/kg	0.46	1.84	400	2600		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Dibromomethane	µg/kg	0.918	1.84	14,000[a]	59,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 UJ
Dichlorodifluoromethane	µg/kg	0.52	1.84	9,400[a]	340,000		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Ethylbenzene	µg/kg	0.497	1.84	13,000	230,000		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Hexachlorobutadiene	µg/kg	1.84	3.67	2,000	2,500		796 U	116 U	5 U	4.8 U	4.8 U	115 U	115 U	4.8 UJ	5.4 U
Isopropylbenzene (Cumene)	µg/kg	0.604	1.84	37,000[a]	58,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115U	2.4 U	2.7 U
Methyl iodide	µg/kg	0.474	1.84	-	-		398 U	NA	2.5 U	2.4 U	2.4 U	NA	NA	2.4 U	2.7 U
Methylene chloride	µg/kg	0.77	4.6	20	22,000		**181 J**	116 U	6.3 U	6 UJ	6 UJ	115 U	115 U	6 UJ	6.8 UJ
MTBE	µg/kg	0.46	1.84	23,000	79,000		398 U	232 U	2.5 U	2.4 U	2.4 U	231 U	231 U	2.4 U	2.7 U
Naphthalene	µg/kg	0.321	1.84	12,000[a]	21,000[a]		398 U	116 U	**1.4 J**	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
n-Butylbenzene	µg/kg	0.367	1.84	14000[a]	240,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
n-Propylbenzene	µg/kg	0.54	1.84	14,000[a]	240,000		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
o-Xylene	µg/kg	0.497	1.84	190,000	280,000		398 U	**33.9 J**	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
p,m-Xylene	µg/kg	1.07	3.67	200,000	210,000		796 U	**30.7 J**	5 U	4.8 U	4.8 U	231 U	231 U	4.8 U	5.4 U
sec-Butylbenzene	µg/kg	0.574	1.84	11,000[a]	220,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Styrene	µg/kg	0.428	1.84	4,000	1,700,000		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
tert-Butylbenzene	µg/kg	0.558	1.84	13,000[a]	390,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Tetrachloroethene	µg/kg	0.918	4.6	60	1,700		995 U	116 U	6.3 U	6 U	**1.8 J**	**1,940**	**1,360**	**2.8 J**	6.8 U
Toluene	µg/kg	0.46	1.84	12,000	520,000		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
trans -1,2-Dichloroethene	µg/kg	0.558	1.84	700	20,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
trans -1,3-Dichloropropene	µg/kg	0.543	1.84	-	-		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Trichloroethene	µg/kg	0.918	1.84	43	100		**5,250**	**1,390**	2.5 U	2.4 U	2.4 U	**53.2 J**	**27.1 J**	2.4 U	2.7 U
Trichlorofluoromethane	µg/kg	0.627	1.84	39,000[a]	140,000[a]		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Vinyl acetate	µg/kg	0.46	1.84	99,000[a]	160,000[a]		398 U	NA	2.5 U	2.4 U	2.4 U	NA	NA	2.4 U	2.7 U
Vinyl chloride	µg/kg	0.474	1.84	10	860		398 U	116 U	2.5 U	2.4 U	2.4 U	115 U	115 U	2.4 U	2.7 U
Corresponding ECD Response (µV)							8,390,720	8,771,673	--	253,968	840,048	6,769,231	8,771,673	175,824	439,560

Note:
Bold = A concentration above the sample quantification limit
Gray highlight = A detected concentration above the selected screening level
Results reported as dry unit weight.
[a] MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
[b] Screening value based on USEPA Region 6 MSSLs for industrial outdoor worker.
[c] Soil samples were analyzed by Applied Sciences Laboratory
ECD = electron capture detector
J = Reported value is estimated
NA = Not Analyzed
U = Not detected above the laboratory reporting limit.
VOC = volatile organic compound
µg/kg = micrograms per kilograms
µV = microvolt

TABLE 2-16
2001 TapanAm and 2005/2006 USACE Groundwater Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

	Sample ID>>	MW-101	MW-101	MW-101	MW-102	MW-102	MW-102	MW-103	MW-103	MW-103
	Year Sampled>>	2001	2005	2006	2001	2005	2006	2001	2005	2006
Metals (mg/L)	**Screening Levels**									
Aluminum	3.7*	**0.458**	**0.608**	**2.5**	ND	ND	ND	ND	ND	ND
Antimony	0.0015*	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	0.045	ND	**0.042**	**0.0478**	ND	**0.0211**	**0.0166**	ND	**0.0352**	**0.0472**
Barium	0.73*	**0.552**	**0.503**	**0.61**	**0.202 J**	**0.32885**	**0.371**	**0.0831 J**	**0.07851**	**0.176 J**
Beryllium	0.0073*	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	0.0018*	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	-	**121**	**114.89**	**120**	**87.6**	**98.861**	**108**	**151**	**206.95**	**193 J**
Chromium	-	**0.011 J**	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	0.073	**0.0168 J**	**0.01017 J**	**0.0144**	ND	ND	ND	**0.0153 J**	**0.0142 J**	**0.0166 B**
Copper	0.14*	ND	ND	**0.0083**	ND	ND	ND	ND	ND	ND
Iron	2.6*	**61**	**73.589**	**81.4**	**1.84**	**28.466**	**28.4**	**3.02**	**38.452**	**52.7**
Lead	0.015	ND	**0.00249**	**0.0024**	ND	**0.000823 J**	ND	ND	ND	ND
Magnesium	-	**56.2**	**53.129**	**56.3**	**44.3**	**50.575**	**55**	**69.1**	**74.716**	**76.5**
Manganese	0.17*	**15.2 J**	**16.138**	**15**	**9.05**	**9.519**	**9.63**	**11.7**	**23.492**	**19**
Mercury	0.00068	NRQ	ND	ND	NRQ	ND	ND	NRQ	ND	**0.00026**
Nickel	0.073*	**0.0184 J**	ND	ND	ND	ND	ND	**0.0227 J**	ND	ND
Postassium	-	ND	ND	ND	ND	ND	**1.89 J**	**2.62 J**	**26.146 J**	**1.54 J**
Selenium	0.018*	ND	**0.00594**	ND	ND	**0.00309**	ND	ND	**0.00421**	ND
Silver	0.018*	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	-	**77**	**68.119**	**81**	**79.3**	**67.51**	**83.2**	**82.1**	**74.654**	**81.9**
Thallium	0.00026*	ND	ND	**0.017**	ND	ND	ND	ND	ND	**0.0103**
Vanadium	0.018*	ND	ND	**0.0082**	ND	ND	ND	ND	ND	ND
Zinc	1.1*	ND	ND	**0.0212**	ND	ND	ND	ND	ND	ND

Notes:

Bold = Detected concentration

Gray highlight = A detected concentration above selected screening level

E = Detected at levels in excess of the upper calibration limit

B = Blank Detection

J = Reported value is estimated

ND = Chemical not detected

NR = Not reported

NRQ = Analysis not requested for this sample

* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

- = No screening level available.

TABLE 2-16
2001 TapanAm and 2005/2006 USACE Groundwater Metals Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

	Sample ID>>	MW-104	MW-104	MW-104	MW-105	MW-105	MW-105	MW-106	MW-106
	Year Sampled>>	2001	2005	2006	2001	2005	2006	2005	2006
Metals (mg/L)	**Screening Levels**								
Aluminum	3.7*	**0.12 J**	**0.545**	**11.1**	ND	**0.232**	**0.678**	**0.4277**	**109**
Antimony	0.0015*	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	0.045	ND	ND	ND	ND	ND	ND	ND	ND
Barium	0.73*	**0.055 J**	**0.0327**	ND	**0.072 J**	**0.125**	**0.061 J**	**0.0793**	**0.189**
Beryllium	0.0073*	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	0.0018*	ND	ND	**0.0078**	ND	ND	ND	ND	ND
Calcium	-	**130**	**119.99**	**112 J**	**33.4**	**48.43**	**47.6**	**68.287**	**62 J**
Chromium	-	ND	ND	**0.0108**	ND	ND	ND	ND	**0.0167**
Cobalt	0.073	ND	ND	**0.0070 B**	ND	ND	ND	ND	ND
Copper	0.14*	ND	ND	**0.0255**	ND	ND	ND	ND	ND
Iron	2.6*	**0.85**	**1.7635**	**16.1**	**0.21**	**0.491**	**0.665**	**0.793**	**10.2**
Lead	0.015	ND	**0.000781 J**	**0.0045 B**	ND	**0.00066 J**	ND	**0.00698**	**0.0202**
Magnesium	-	**52.1**	**47.198**	**45.7**	**12.9**	**20.398**	**20.7**	**26.112**	**27.6**
Manganese	0.17*	**9.41**	**7.3307**	**7.17**	**0.131**	**0.0383**	**0.0169**	**0.257**	**0.124**
Mercury	0.00068	NRQ	ND	ND	NRQ	ND	ND	ND	ND
Nickel	0.073*	ND	ND	**0.0116 B**	ND	ND	ND	ND	ND
Postassium	-	**2.61 J**	ND	**4.66 J**	ND	ND	ND	ND	**1.77 J**
Selenium	0.018*	ND	**0.00116 J**	ND	ND	**0.00218**	ND	**0.004**	**0.0052**
Silver	0.018*	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	-	**58.5**	**47.075**	**50.6**	**23.6**	**24.117**	**26**	**37.311**	**38.7**
Thallium	0.00026*	ND	ND	ND	ND	ND	ND	ND	**0.0033 B**
Vanadium	0.018*	ND	ND	**0.0219**	ND	ND	ND	ND	**0.022 B**
Zinc	1.1*	ND	ND	**0.0309**	ND	ND	**0.0112 B**	ND	**0.0485**

Notes:

Bold = Detected concentration

Gray highlight = A detected concentration above selected screening level

E = Detected at levels in excess of the upper calibration limit

B = Blank Detection

J = Reported value is estimated

ND = Chemical not detected

NR = Not reported

NRQ = Analysis not requested for this sample

* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

- = No screening level available.

TABLE 2-17
Groundwater VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

			Location>>	MW-106	MW-106	MW-106	MW-106	MW-106	MW-107	MW-107	MW-107	MW-108	MW-108	MW-108
			Sample Date>>	2/1/2005	Feb-06	4/21/2007	6/3/2008	8/13/2010	4/20/2007	6/5/2008	8/11/2010	4/20/2007	6/4/2008	8/11/2010
	Units	Screening Level	Test Method											
1,1,1,2-Tetrachloroethane	µg/L	0.43	SW8260B	NA	NA	5 U	1 U	0.5 U	5 U	1 UJ	0.5 U	5 U	1 U	0.5 U
1,1,2,2-Tetrachloroethane	µg/L	0.055	SW8260B	NA	NA	5 U	1 U	1 U	5 U	1 U	1 U	5 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	0.2	SW8260B	NA	NA	NA	1 U	1.1 U	NA	1 UJ	1.1 U	NA	1 U	1.1 U
1,2-Dichloroethane	µg/L	0.12	SW8260B	**62.2**	**4.3 J**	**4.4 J**	**3.3**	**54.9**	**3.0 J**	1 UJ	**22.7**	5 U	1 U	0.5 U
Benzene	µg/L	0.35	SW8260B	ND	5 U	5 U	1 U	0.5 U	5 U	1 UJ	0.5 U	5 U	1 U	0.5 U
Carbon tetrachloride	µg/L	0.17	SW8260B	ND	5 U	5 U	1 U	1 U	5 U	1 UJ	1 U	5 U	1 U	1 U
Chloroform	µg/L	0.17	SW8260B	ND	5 U	5 U	1 U	0.5 U	5 U	1 U	0.5 U	5 U	1 U	0.5 U
cis -1,2-Dichloroethene	µg/L	6.1*	SW8260B	ND	5 U	5 U	1 U	0.5 U	5 U	1 UJ	**0.57**	**10**	**9.4**	**6.6**
Methylene chloride	µg/L	4	SW8260B	ND	5 U	NA	0.54 U	5 U	NA	1 UJ	5 U	NA	0.53 U	5 U
Naphthalene	µg/L	0.62*	SW8260B	NA	NA	NA	1 U	5 R	NA	1 UJ	5 U	NA	1 U	5 U
Tetrachloroethene	µg/L	0.1	SW8260B	**0.34 J**	**0.44 J**	5 U	1 U	**0.32 J**	5 U	1 U	1.1 U	5 U	1 U	1.1 U
trans -1,2-Dichloroethene	µg/L	11*	SW8260B	ND	5 U	5 U	1 U	0.5 U	5 U	1 UJ	0.5 U	**0.54 J**	**0.6 J**	**0.35 J**
Trichloroethene	µg/L	0.028	SW8260B	**0.28 J**	5 U	5 U	1 U	**0.21 J**	5 U	1 U	**0.39 J**	**18**	**16.8**	**4.6**
Vinyl chloride	µg/L	0.015	SW8260B	ND	5 U	5 U	1 U	1 U	5 U	1 U	1 U	5 U	1 U	**0.19 J**

Note:
* USEPA Region 6 Medium-Specific Screening Levels for residential water adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.
D = Quantified at dilution
J = Reported value is estimated
NA = Not Analyzed
ND = Not Detected
R = The sample results are rejected due to deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.
U = Not detected above the laboratory reporting limit.
VOC = volatile organic compound
Bold indicates the analyte was detected
Shading indicates the analyte exceeded screening criteria

TABLE 2-17
Groundwater VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

			Location>>	MW-109	MW-109	MW-109	MW-110	MW-110	MW-110	MW-111	MW-111	MW-111
			Sample Date>>	4/22/2007	6/4/2008	8/11/2010	4/22/2007	6/5/2008	8/11/2010	4/21/2007	6/6/2008	8/13/2010
	Units	Screening Level	Test Method									
1,1,1,2-Tetrachloroethane	µg/L	0.43	SW8260B	5 U	1 U	0.5 U	5 U	20 UJ	25 U	**16**	50 U	**17.4 J**
1,1,2,2-Tetrachloroethane	µg/L	0.055	SW8260B	5 U	1 U	1 U	5 U	20 U	50 U	**0.58 J**	50 U	100 U
1,1,2-Trichloroethane	µg/L	0.2	SW8260B	NA	1 U	1.1 U	NA	20 UJ	57 U	NA	50 U	114 U
1,2-Dichloroethane	µg/L	0.12	SW8260B	5 U	1 U	0.5 U	**150**	**100 J**	**68.2**	5 U	50 U	50 U
Benzene	µg/L	0.35	SW8260B	5 U	1 U	0.5 U	5 U	20 UJ	25 U	**0.22 J**	50 U	50 U
Carbon tetrachloride	µg/L	0.17	SW8260B	5 U	1 U	1 U	5 U	20 UJ	51 U	**2.7 J**	50 U	102 U
Chloroform	µg/L	0.17	SW8260B	5 U	1 U	0.5 U	**0.35 J**	20 U	25 U	**20**	**23.8 J**	**21.7 J**
cis -1,2-Dichloroethene	µg/L	6.1*	SW8260B	**1.7 J**	**1.5**	**1.3**	**46**	**82.2 J**	**143**	**250 JD**	**281**	**330**
Methylene chloride	µg/L	4	SW8260B	NA	1	5 U	NA	20 UJ	250 U	NA	50 U	**139 J**
Naphthalene	µg/L	0.62*	SW8260B	NA	1 U	5 U	NA	20 UJ	250 U	NA	50 U	500 R
Tetrachloroethene	µg/L	0.1	SW8260B	**3.9 J**	**2.9**	**1 J**	**7,700 D**	**9,440**	**13,400**	**29,000 D**	**34,900**	**43,300**
trans -1,2-Dichloroethene	µg/L	11*	SW8260B	5 U	1 U	0.5 U	**0.93 J**	20 UJ	25 U	**12**	50 U	50 U
Trichloroethene	µg/L	0.028	SW8260B	**5.8**	**5.1**	**2.5**	**82**	**129**	**203**	**1,400 D**	**1,620**	**1,610**
Vinyl chloride	µg/L	0.015	SW8260B	5 U	1 U	1 U	5 U	20 U	50 U	**0.32 J**	50 U	100 U

Note:

* USEPA Region 6 Medium-Specific Screening Levels for residential wa
factor of 10 to account for cumulative effects from multiple noncarcinog
target organ.

D = Quantified at dilution

J = Reported value is estimated

NA = Not Analyzed

ND = Not Detected

R = The sample results are rejected due to deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.

U = Not detected above the laboratory reporting limit.

VOC = volatile organic compound

Bold indicates the analyte was detected

Shading indicates the analyte exceeded screening criteria

TABLE 2-17
Groundwater VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

			Location>>	MW-112	MW-112	MW-112	MW-113	MW-113	MW-113	MW-114	MW-114	MW-114	MW-115	MW-115
			Sample Date>>	4/22/2007	6/5/2008	8/13/2010	4/21/2007	6/4/2008	8/12/2010	4/22/2007	6/3/2008	8/11/2010	6/5/2008	8/13/2010
	Units	Screening Level	Test Method											
1,1,1,2-Tetrachloroethane	µg/L	0.43	SW8260B	5 U	1 UJ	0.5 U	5 U	1 U	0.5 U	5 U	1 U	0.5 U	1 UJ	0.5 U
1,1,2,2-Tetrachloroethane	µg/L	0.055	SW8260B	5 U	1 U	1 U	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	0.2	SW8260B	NA	1 UJ	1.1 U	NA	1 U	1.1 U	NA	1 U	1.1 U	1 UJ	1.1 U
1,2-Dichloroethane	µg/L	0.12	SW8260B	5 U	1 UJ	**0.21 J**	5 U	1 U	0.5 U	**3.3 J**	1 U	0.5 U	1 UJ	0.5 U
Benzene	µg/L	0.35	SW8260B	5 U	1 UJ	0.5 U	5 U	1 U	0.5 U	5 U	1 U	0.5 U	1 UJ	0.5 U
Carbon tetrachloride	µg/L	0.17	SW8260B	5 U	1 UJ	1 U	5 U	1 U	1 U	5 U	1 U	1 U	**0.38 J**	1 U
Chloroform	µg/L	0.17	SW8260B	5 U	1 U	0.5 U	5 U	1 U	0.5 U	5 U	1 U	0.5 U	1 U	0.5 U
cis -1,2-Dichloroethene	µg/L	6.1*	SW8260B	5 U	1 UJ	0.5 U	5 U	1 U	0.5 U	5 U	1 U	**0.26 J**	1 UJ	0.5 U
Methylene chloride	µg/L	4	SW8260B	NA	1 UJ	5 U	NA	1 R	5 U	NA	1 R	5 U	1 UJ	5 U
Naphthalene	µg/L	0.62*	SW8260B	NA	1 UJ	5 R	NA	1 U	5 R	NA	1 U	5 U	1 UJ	5 R
Tetrachloroethene	µg/L	0.1	SW8260B	5 U	1 U	1.1 U	5 U	**0.88 J**	1.1 U	5 U	**0.64 J**	**0.58 J**	1 U	1.1 U
trans -1,2-Dichloroethene	µg/L	11*	SW8260B	5 U	1 UJ	0.5 U	5 U	1 U	0.5 U	5 U	1 U	0.5 U	1 UJ	0.5 U
Trichloroethene	µg/L	0.028	SW8260B	5 U	1 U	0.5 U	5 U	1 U	0.5 U	5 U	**0.54 J**	**0.62**	1 U	0.5 U
Vinyl chloride	µg/L	0.015	SW8260B	5 U	1 U	1 U	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U

Note:

* USEPA Region 6 Medium-Specific Screening Levels for residential wa
factor of 10 to account for cumulative effects from multiple noncarcinog
target organ.

D = Quantified at dilution

J = Reported value is estimated

NA = Not Analyzed

ND = Not Detected

R = The sample results are rejected due to deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.

U = Not detected above the laboratory reporting limit.

VOC = volatile organic compound

Bold indicates the analyte was detected

Shading indicates the analyte exceeded screening criteria

TABLE 2-17
Groundwater VOC Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

			Location>>	MW-116	MW-116	MW-117	MW-118
			Sample Date>>	6/4/2008	8/11/2010	6/12/2008	8/13/2010
	Units	Screening Level	Test Method				
1,1,1,2-Tetrachloroethane	µg/L	0.43	SW8260B	1 U	0.5 U	1 U	2.5 U
1,1,2,2-Tetrachloroethane	µg/L	0.055	SW8260B	1 U	1 U	1 U	5 U
1,1,2-Trichloroethane	µg/L	0.2	SW8260B	1 U	1.1 U	1 U	**1.4 J**
1,2-Dichloroethane	µg/L	0.12	SW8260B	1 U	0.5 U	1 U	2.5 U
Benzene	µg/L	0.35	SW8260B	1 U	0.5 U	1 U	**1.8 J**
Carbon tetrachloride	µg/L	0.17	SW8260B	1 UJ	1 U	1 U	**1,480**
Chloroform	µg/L	0.17	SW8260B	1 U	0.5 U	1 U	**165**
cis -1,2-Dichloroethene	µg/L	6.1*	SW8260B	1 U	0.5 U	1 U	2.5 U
Methylene chloride	µg/L	4	SW8260B	1 U	5 U	1 U	**5.9 J**
Naphthalene	µg/L	0.62*	SW8260B	1 U	5 U	1 UJ	25 R
Tetrachloroethene	µg/L	0.1	SW8260B	1 U	1.1 U	1 U	5.7 U
trans -1,2-Dichloroethene	µg/L	11*	SW8260B	1 U	0.5 U	1 U	2.5 U
Trichloroethene	µg/L	0.028	SW8260B	1 U	0.5 U	1 U	**809**
Vinyl chloride	µg/L	0.015	SW8260B	1 UJ	1 U	1 U	5 U

Note:

* USEPA Region 6 Medium-Specific Screening Levels for residential wa
factor of 10 to account for cumulative effects from multiple noncarcinog
target organ.

D = Quantified at dilution

J = Reported value is estimated

NA = Not Analyzed

ND = Not Detected

R = The sample results are rejected due to deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.

U = Not detected above the laboratory reporting limit.

VOC = volatile organic compound

Bold indicates the analyte was detected

Shading indicates the analyte exceeded screening criteria

TABLE 2-18
Indoor and Ambient Air Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Analyte	Minimum Detection Limit	Minimum Reporting Limit	Test Method	Outdoor Ambient Air March 2008	Outdoor Ambient Air May 2008	Indoor Air Southwest Corner of Basement March 2008	Indoor Air Southwest Corner of Basement May 2008	Indoor Air Northeast Corner of Basement March 2008	Indoor Air Northeast Corner of Basement May 2008
Vinyl Chloride	0.00092	0.021	TO15SIM	0.024 U	0.036 U	0.0047 J	0.036 U	0.023 U	0.043 U
trans-1,2-Dichloroethene	0.0026	0.03	TO15SIM	0.0052 J	0.036 U	0.013 J	0.036 U	0.012 J	0.043 U
cis-1,2-Dichloroethene	0.0036	0.03	TO15SIM	0.036 U	0.036 U	**0.18**	**0.044**	**0.15**	**0.058**
1,2-Dichloroethane	0.0025	0.03	TO15SIM	**0.075**	**0.06**	**0.088**	**0.063**	**0.072**	**0.062**
Trichloroethene	0.0041	0.01	TO15SIM	**0.19**	**0.019**	**1.1**	**0.13**	**0.41**	**0.16**
Tetrachloroethene	0.0038	0.03	TO15SIM	**0.3**	**0.099**	**0.91**	**0.1**	0.250 U	**0.12**

Note:
Bold = A concentration above the sample quantification
Gray highlight = A detected concentration above the recommended screening level
U = Not detected above the reported quantitation limit
J = Reported value is estimated
All units in micrograms per cubic meter ($\mu g/m^3$)

TABLE 2-19
2001 TapanAm Sediment TAL Metals and Explosives Analytical Results
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Sample ID>>	SED-PW1	SED-PW2	SED-PW8	SED-PW9	SED-PW10	SED-PW11	SED-PW12	SED-PW13	SED-PW14	SED-PW15	SED-PW16	SED-PW17	SED-PW18	SED-PW19	SED-PW20	SED-PW21	SED-PW22	SED-PW25
Target Analyte List Metals (mg/kg)	Test Method	Screening Level																		
Aluminum	6010B, 6020B	7,700*	**6,298.1**	**7,976.6**	**1,148.4**	**3,729**	**14,820**	**1286.6**	**44,378**	**26,883**	**39,560**	**9,644.8**	**10,189**	**3,614.20**	**13,438**	**10,372**	**15,618**	**9,155.8**	**15,598**	**8,233**
Antimony	6010B, 6020B	3.1*	ND	**2.75 J**	ND	ND	ND	ND	**42.7 J**	**13.87**	ND	ND	ND	ND	ND	ND	ND	ND	**253.8**	ND
Arsenic	6010B, 6020B	12.3	ND	**13.07 J**	ND	**34.02**	**21.575**	ND	ND	ND	**20.289 J**	**32.815**	**13.502**	ND	ND	**31.725 J**	ND	ND	ND	ND
Barium	6010B, 6020B	1,600*	**66.703 J**	**82.56**	**209.42**	**69.815**	**250.33**	**27.546 J**	**7,508.1**	**2,349.2**	ND	**2,231.7**	**1,560.8**	**1,735.6**	**1,274.5**	**1,587.30**	**358.52**	**321.5**	**564.91**	**72.869**
Beryllium	6010B, 6020B	16*	**0.491 J**	**0.759**	**0.386 J**	**0.458 J**	**0.86688 J**	ND	ND	**0.511 J**	**0.52686 J**	**0.51952 J**	**0.42615 J**	ND	**0.49381 J**	**0.70163 J**	**0.86588 J**	**0.60245 J**	**0.83045 J**	**0.4271 J**
Cadmium	6010B, 6020B	3.9*	**3.099 J**	**3.036**	**4.062**	**7.596**	**11.18**	**3.265 J**	**29.024**	**14.96**	**24.639**	**20.986**	**6.5481**	**25.872**	**50.268**	**21.086**	**13.302**	**11.945**	**21.602**	**2.8004**
Calcium	6010B, 6020B	-	**139,860**	**18,364**	**127,970**	**77,509**	**34,607**	**224,390**	**39,810**	**27,286**	**23,356**	**18,380**	**15,614**	**16,784**	**9,347.8**	**11,648**	**5,451.7**	**4,270.10**	**7,373**	**14,705**
Chromium	6010B, 6020B	38	**18.776**	**18.636**	**16.173**	**23.568**	**52.506**	**6.32 J**	**77.947**	**73.495**	**84.278**	**87.239**	**31.641**	ND	**145.51**	**97.289**	ND	**60.617**	ND	**15.55**
Cobalt	6010B, 6020B	900	**7.419 J**	**12.494**	**11.894 J**	**9.194 J**	ND	ND	**19.46 J**	**10.783**	**19.344 J**	**16.196**	ND	ND	**33.982**	**15.868 J**	ND	**14.515 J**	**15.689 J**	**5.3281 J**
Copper	6010B, 6020B	290*	**49.916 J**	**203.46**	**246.74**	**773.85**	**2,450.8**	**165.25**	**1,339**	**534.92**	**927.09**	**620.72**	**215.64**	**448.98**	**942.15**	**1,033.6**	**358.17**	**444.21**	**681.37**	**209.62**
Iron	6010B, 6020B	5,500*	**15,514**	**16,245**	**15,213**	**16,769**	**24,190**	**5,147.2**	**74,644**	**23,685**	**70,201**	**35,916**	**23,547**	ND	ND	**75,359**	ND	**72,188**	**62,661**	**13,286**
Lead	6010B, 6020B	400	**418.98**	**636.58**	**3,732.3**	**1,075.3**	ND	**455.51**	**2,803.8**	**1,507.4**	**2,339.3**	**1,925.3**	ND	**25,387**	**2,481.5**	ND	**3,567.1**	**1,054.8**	**3,692.7**	**245.51**
Magnesium	6010B, 6020B	-	**24,458**	**5,744.3**	**28,528**	**20,097**	**12,404**	**38,508**	**54,174**	**32,295**	**40,609**	**10,909**	**10,081**	**7,449.6**	**11,946**	**9,234.9**	**10,973**	**5,308.9**	**12,769**	**4,301**
Manganese	6010B, 6020B	350*	**374.31**	**293.8**	**1,140**	**617.53**	**319.85**	**114.11**	**649.65**	**503.76**	**455.58**	**315.98**	**421.24**	**146.56**	**301.3**	**439.57**	**299.62**	**711.94**	**396.2**	**293.31**
Mercury	6010B, 6020B	2.3*	ND	ND	ND	ND	**0.209 J**	ND	ND	ND	**0.23 J**	**4.954**	**0.354**	**7.112**	**0.464 J**	ND	ND	ND	**0.522**	**0.147 J**
Nickel	6010B, 6020B	130	**18.979 J**	**22.957**	**15.503 J**	**18.649**	**34.996**	ND	**63.493**	**36.53**	**63.052**	**75.198**	**23.981**	**46.712**	**69.237**	**59.015**	**47.915**	**59.971**	**93.414**	**12.645**
Potassium	6010B, 6020B	-	**1,102.7 J**	**652.73 J**	ND	**357.69 J**	**1,213.6**	ND	ND	**392.49 J**	**1,279 J**	**992.09 J**	**1,148**	ND	**1,075.4 J**	**1,289.4 J**	**2,608.6**	**964.51 J**	**2,423.5**	**1,299.9**
Selenium	6010B, 6020B	5	ND	ND	ND	ND	**16.256 J**	ND	ND	**19.21**	**71.041**	**33.008**	**10.869 J**	**24.303 J**	**112.45**	ND	ND	ND	ND	ND
Silver	6010B, 6020B	34	ND	ND	ND	ND	**2.2803**	ND	ND	**100.32**	ND	**5.197**	ND	**2.8539 J**	**38.533**	ND	ND	ND	ND	ND
Sodium	6010B, 6020B	-	**130.06 J**	**56.07 J**	**88.47 J**	**122.01 J**	**236.71 J**	**264.34 J**	**226.31 J**	**233.02 J**	**368.61 J**	**159.74 J**	**125.41 J**	**189.34 J**	**405.07 J**	**168.7 J**	**361.45 J**	**85.994 J**	**1,611 J**	**54.652 J**
Thallium	6010B, 6020B	0.7	ND	ND	ND	ND	ND	ND	ND	**3.58 J**	**25.506 J**	**8.4165 J**	**7.5503 J**	**14.669 J**	ND	**16.407 J**	**11.471 J**	ND	**13.849 J**	**4.0795 J**
Vanadium	6010B, 6020B	39*	**19.492 J**	**28.25**	**7.223 J**	**15.086**	**45.22**	**4.989 J**	**27.909 J**	**17.818**	**40.431**	**42.788**	**26.75**	**11.153 J**	**62.454**	**41.809**	**49.095**	**42.729**	**50.883**	**24.073**
Zinc	6010B, 6020B	2,300*	**247.12**	**477.51**	**1,159.1**	**1,005.7**	ND	**265.42**	**2,719.2**	**2,718.3**	**18,026**	**4,131**	ND	**5,874.4**	**17,554**	**2,937**	ND	**1,296.3**	ND	**438.68**
Explosives (mg/kg)	**Test Method**																			
1,3,5-Trinitrobenzene	8330	180*	ND	ND	ND	ND	**0.956121**	ND	ND	ND	**0.186067 J**	ND	ND	ND	ND	ND	ND	ND	ND	NA
1,3-Dinitrobenzene	8330	0.61*	ND	ND	ND	ND	**0.109497 J**	ND	ND	ND	ND	**0.108329 J**	**0.119342 J**	ND	ND	ND	ND	ND	ND	NA
2,4,6-Trinitrotoluene	8330	16	ND	ND	ND	ND	ND	ND	ND	ND	**0.138634 J**	ND	**0.585329**	ND	ND	**0.436835 J**	ND	ND	**J**	NA
2,4-Dinitrotoluene	8330	12*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.313624 J**	ND	ND	ND	NA
2,6-Dinitrotoluene	8330	6.1*	ND	ND	**0.185945 J**	ND	ND	ND	**0.543724 J**	ND	ND	**0.257392 J**	**2.37759**	ND	ND	ND	**2.26876**	**2.52715**	**1.46349**	NA
2-Amino-4,6-dinitrotoluene	8330	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.224649 J**	**0.278474 J**	**1.62898**	ND	**0.189439 J**	ND	ND	ND	NA
2-Nitrotoluene	8330	160*	**0.19847 J**	**0.190825 J**	**0.152067 J**	**0.134159 J**	**0.293988 J**	**J**	**0.29266 J**	**0.250844 J**	**0.245209 J**	**0.227054 J**	**1.03866**	**0.379101 J**	**0.209014 J**	**0.237379 J**	**0.417755 J**	**0.184827 J**	**0.457519 J**	NA
4-Amino-2,6-dinitrotoluene	8330	-	ND	**0.848824**	ND	ND	**0.212622 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
4-Nitrotoluene	8330	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
HMX	8330	310*	**0.118892 J**	**0.186476 J**	**0.118749 J**	**0.140816 J**	**0.188532 J**	**0.412087 J**	**0.183575 J**	**0.343746 J**	**0.154288 J**	**0.237909 J**	ND	ND	**0.378299 J**	**0.141756 J**	ND	**0.153718 J**	ND	NA
Nitrobenzene	8330	2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.267917 J**	ND	ND	ND	ND	ND	ND	NA
PETN	8330	-	ND	ND	ND	ND	**3.61368 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
RDX	8330	4.4	**0.686737**	**0.691961**	**0.625828**	**0.699377**	**2.06435**	**0.81987**	**0.585869 J**	**1.02918**	**2.94037**	**1.04044**	**0.450407 J**	**1.12378**	**2.55622**	**3.1504**	**0.612774 J**	**1.19549**	**0.19899 J**	NA
Tetryl	8330	-	ND	ND	**0.1381 J**	ND	**0.209092 J**	ND	**0.535441 J**	**0.249584 J**	ND	**0.197291 J**	**0.1542 J**	**0.233246 J**	ND	**0.320851 J**	ND	**0.157623 J**	**0.127007 J**	NA
Trinitrogycerin	8330	-	ND	ND	ND	ND	**10.19427 J**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA

Note:
Bold = Detected concentration
Gray highlight = A detected concentration above the selected screening level.
mg/kg = milligrams per kilogram
B = Blank detection
J = Reported value is estimated
NA = Sample was not analyzed
ND = Chemical not detected
- = No screening level available

TABLE 2-20

Summary of Estimated Carcinogenic Risks and Non-carcinogenic Hazard Indices
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Excess Lifetime Cancer Risk (ELCR)					**Non-Carcinogenic Hazard Indices (HIs)**				
Exposure Points	Receptor Group & Exposure Scenarios	Ingestion	Dermal Contact	Inhalation	Total ELCR	Carcinogenic COC[c]	Ingestion	Dermal Contact	Inhalation	Screening HI	Non-carcinogenic COC[d]
Onsite Soil (0-2 ft bgs Sitewide)	Industrial Worker Soil (0-2 ft bgs)	3.5E-06	2.3E-06	3.2E-06	**9E-06**	--	0.017	0.0017	0.0058	0.02	--
Onsite Soil (0-10 ft bgs Sitewide) and Onsite Groundwater[a]	Construction Worker Onsite Soil (0-10 ft bgs)	8.0E-07	2.8E-07	8.7E-08	1.2E-06	--	0.11	0.012	0.0040	0.12	--
	Construction Worker Onsite Groundwater (Excavations Downgradient of Building 220)	NA	1.1E-05	1.1E-06	1.2E-05	--	NA	3.0	0.52	3.5	Carbon tetrachloride, PCE
	Construction Worker Onsite Groundwater and Soil Total				**1E-05**	--				**4**	
Offsite Groundwater	Construction Worker Offsite Groundwater (Excavations)	NA	1.0E-06	7.8E-08	**1E-06**	--	NA	0.18	0.039	0.2	--
	Residential Child Offsite Groundwater	-	-	-	-	--	27	13	177	217	1,2-DCA, Manganese, PCE, TCE
	Residential Adult/Child (Aggregate) Offsite Groundwater	2.7E-02	1.6E-02	7.0E-02	**1E-01**	1,2-DCA, PCE, TCE, Chloroform	-	-	-	-	--
	Residential Adult Offsite Groundwater	-	-	-	-	--	12	6	99	117	1,2-DCA, Manganese, PCE, TCE
Soil (0-10 ft bgs) at Unit A and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	0.56	0.0064	0.0089	0.57	--
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					--				**0.7**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.060	0.0010	0.0089	0.070	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					--				**0.1**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	NA	NA	NA	NA	--	-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						
Soil (0-10 ft bgs) at Unit B and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	1.21	0.064	0.0099	1.3	--
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					--				**1.4**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.13	0.010	0.0099	0.15	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					--				**0.2**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	3.8E-05	3.6E-06	2.1E-08	4.1E-05		-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4.2E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**5E-04**						
Soil (0-10 ft bgs) at Unit C and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	0.62	0.0076	0.0098	0.64	--
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					--				**0.7**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.066	0.0012	0.0098	0.077	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					--				**0.1**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	NA	NA	NA	NA	--	-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						

TABLE 2-20

Summary of Estimated Carcinogenic Risks and Non-carcinogenic Hazard Indices
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Excess Lifetime Cancer Risk (ELCR)					Non-Carcinogenic Hazard Indices (HIs)				
Exposure Points	Receptor Group & Exposure Scenarios	Ingestion	Dermal Contact	Inhalation	Total ELCR	Carcinogenic COC[c]	Ingestion	Dermal Contact	Inhalation	Screening HI	Non-carcinogenic COC[d]
Soil (0-10 ft bgs) at Unit D and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	1.48	0.0093	0.0135	1.5	--
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					**--**				**1.6**	
		-	-	-	-	--	0.16	0.001	0.0135	0.17	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					**--**				**0.2**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	NA	NA	NA	NA	--	-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						
Soil (0-10 ft bgs) at Unit E and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	2.6	0.1	0.0135	2.7	Thallium, Antimony
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					**--**				**3**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.28	0.011	0.0135	0.30	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					**--**				**0.4**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	3.2E-05	3.1E-06	1.7E-07	3.5E-05		-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4.2E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**5E-04**						
Soil (0-10 ft bgs) at Unit F and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	1.52	0.047	0.0125	1.6	--
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					**--**				**1.7**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.163	0.0072	0.0125	0.18	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					**--**				**0.2**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	2.0E-05	1.9E-06	1.1E-08	2.2E-05		-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4.2E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						
Soil (0-10 ft bgs) at Unit G and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	1.6	0.017	0.0143	1.7	**--**
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	**--**
	Residential Child Groundwater and Soil Total					**--**				**1.8**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.177	0.003	0.0143	0.19	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	**--**
	Residential Adult Groundwater and Soil Total					**--**				**0.2**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	9.3E-07	3.8E-07	2.7E-11	1.3E-06	--	-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4.2E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						

TABLE 2-20

Summary of Estimated Carcinogenic Risks and Non-carcinogenic Hazard Indices
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Excess Lifetime Cancer Risk (ELCR)					Non-Carcinogenic Hazard Indices (HIs)				
Exposure Points	Receptor Group & Exposure Scenarios	Ingestion	Dermal Contact	Inhalation	Total ELCR	Carcinogenic COC[c]	Ingestion	Dermal Contact	Inhalation	Screening HI	Non-carcinogenic COC[d]
Soil (0-10 ft bgs) at Unit H and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	2.0	0.058	0.010	2.0	--
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					**--**				**2**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.21	0.0089	0.010	0.23	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					**--**				**0.3**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	2.5E-05	2.4E-06	1.4E-08	2.8E-05		-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4.2E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						
Soil (0-10 ft bgs) at Unit I and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	1.64	0.010	0.0142	1.7	Thallium
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					**--**				**1.8**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.18	0.00	0.0142	0.19	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					**--**					
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	NA	NA	NA	NA	--	-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						
Soil (0-10 ft bgs) at Unit J and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	2.8	0.057	0.0122	2.9	Thallium
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					**--**				**3**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.301	0.01	0.0122	0.32	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					**--**				**0.4**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	3.1E-05	3.1E-06	1.7E-08	3.4E-05		-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4.2E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						
Soil (0-10 ft bgs) at Unit K and Onsite Groundwater[b]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	2.1	0.017	0.0132	2.1	Thallium
	Residential Child Onsite Groundwater	-	-	-	-	--	0.049	0.010	0.054	0.11	--
	Residential Child Groundwater and Soil Total					**--**				**2**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.22	0.003	0.0132	0.24	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	0.021	0.0043	0.030	0.056	--
	Residential Adult Groundwater and Soil Total					**--**				**0.3**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	NA	NA	NA	NA	--	-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	6.7E-06	4.9E-07	4.1E-04	4.2E-04	1,2-DCA, Carbon tetrachloride	-	-	-	-	--
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**4E-04**						

TABLE 2-20

Summary of Estimated Carcinogenic Risks and Non-carcinogenic Hazard Indices
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

		Excess Lifetime Cancer Risk (ELCR)					**Non-Carcinogenic Hazard Indices (HIs)**				
Exposure Points	Receptor Group & Exposure Scenarios	Ingestion	Dermal Contact	Inhalation	Total ELCR	Carcinogenic COC[c]	Ingestion	Dermal Contact	Inhalation	Screening HI	Non-carcinogenic COC[d]
Soil (0-10 ft bgs) at Unit L and Onsite Groundwater[a]	Residential Child Soil (0-10 ft bgs)	-	-	-	-	--	1.1	0.026	0.019	1.1	
	Residential Child Onsite Groundwater	-	-	-	-	--	433	166	1640	2239	1,2-DCA, Benzene, Carbon tetrachloride, Chloroform, cis-1,2-DCE, Manganese, Naphthalene, PCE, trans-1,2-DCE, TCE
	Residential Child Groundwater and Soil Total									**2240**	
	Residential Adult Soil (0-10 ft bgs)	-	-	-	-	--	0.11	0.0040	0.019	0.14	--
	Residential Adult Onsite Groundwater	-	-	-	-	--	186	74	922	1182	1,2-DCA, Benzene, Carbon tetrachloride, Chloroform, cis-1,2-DCE, Manganese, Naphthalene, PCE, trans-1,2-DCE, TCE
	Residential Adult Groundwater and Soil Total									**1182**	
	Residential Adult/Child (Aggregate) Soil (0-10 ft bgs)	2.2E-06	6.9E-06	3.5E-06	1.3E-05	--	-	-	-	-	--
	Residential Adult/Child (Aggregate) Onsite Groundwater	1.9E-01	1.2E-01	5.6E-01	8.7E-01	1,1,1,2-TeCA, 1,1,2,2-TeCA, 1,1,2-TCA, 1,2-DCA, Benzene, Carbon tetrachloride, Chloroform, Naphthalene, PCE, TCE	-	-	-	-	
	Residential Adult/Child (Aggregate) Groundwater and Soil Total				**9E-01**						--

Notes:
Total ELCRs and HIs are presented in **bold** font to distinguish them from component ELCRs and HIs that comprise the totals.
NA = Not applicable or not available

[a] Groundwater exposures were quantified for groundwater downgradient of Building 220.

[b] Groundwater exposures were quantified for sitewide groundwater, excluding the area downgradient of Building 220.

[c] If the receptor ELCR exceeds 1E-04, risk drivers/COCs were identified as individual chemicals with an ELCR greater than 1E-05 for the environmental medium driving the risk.

[d] If a target organ HI exceeds 1.0, HI drivers/COCs were identified as chemicals with an individual HI greater than 0.1 contributing to the target organ HI exceeding 1.0 for the environmental medium driving the risk.

DCA = dichloroethane, DCE = dichloroethene, PCE = tetrachloroethene, TCA = trichloroethane, TCE = trichloroethene, TeCA = tetrachloroethane

TABLE 2-21
Detailed Evaluation of Remedial Alternatives
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Evaluation Criteria	Alternative 1 No Action	Alternative 2 In Situ Groundwater Treatment Using Thermal Technologies, Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 3 In Situ Groundwater Treatment and Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 4 Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal and Offsite Disposal
Overall Protection to Human Health and the Environment				
Protection of human health and the environment	St. Louis Ordinance 66777 prohibits the installation of potable water supply wells in the City of St. Louis, which encompasses the site and downgradient offsite properties. Therefore, Alternative 1 protects against potable use of groundwater. Alternative 1 is not protective for RAOs pertaining to potential construction worker risks to groundwater or risks to receptors associated with COC concentrations in soil.	Alternative 2 protects against potable use of groundwater because of St. Louis Ordinance 66777. Treatment would eliminate potential construction worker risk within Plume A TTZ. Groundwater monitoring and inspections of Plume C would be protective of the potential construction worker direct contact risk by verifying that groundwater levels are deeper than 10 feet below ground and notifying hypothetical receptors accordingly, should that assumption be proven invalid during monitoring. Removal of metals and Aroclor 1260 from the soil and sediment meets the ARARs and is protective of receptors.	For the reasons described under Alternative 2, this alternative would be protective.	For the reasons described under Alternative 2, this alternative would be protective.
Compliance with ARARs				
Action-specific ARARs	In compliance.	In compliance.	In compliance.	In compliance.
Chemical-specific ARARs	Not in compliance.	In compliance. Remediation goals eventually would be met.	In compliance. Remediation goals eventually would be met.	In compliance. Remediation goals eventually would be met.
Long-Term Effectiveness and Permanence				
Magnitude of residual risk	No residual risks to potable use receptors because of the existing ordinance. Risks to construction workers would remain.	No residual risks to potable use receptors because of the existing ordinance. Residual risk to the construction worker would be minimal due to treatment and minimal exposure. No residual risk to soil COCs.	No residual risks to potable use receptors because of the existing ordinance. Residual risk to the construction worker would be minimal due to treatment and minimal exposure. No residual risk to soil COCs.	No residual risks to potable use receptors because of the existing ordinance. Residual risk to the construction worker would be minimal due to treatment and minimal exposure. No residual risk to soil COCs.

TABLE 2-21
Detailed Evaluation of Remedial Alternatives
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Evaluation Criteria	Alternative 1 No Action	Alternative 2 In Situ Groundwater Treatment Using Thermal Technologies, Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 3 In Situ Groundwater Treatment and Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 4 Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal and Offsite Disposal
Adequacy and reliability of controls	Reliable for the potable use exposure. No controls for the other receptors.	Reliable for the potable use exposure. Five-year reviews allow for future evaluations of the exposure pathways associated with potential future risk after the remedial actions.	Reliable for the potable use exposure. Five-year reviews allow for future evaluations of the exposure pathways associated with potential future risk after the remedial actions.	Reliable for the potable use exposure. Five-year reviews allow for future evaluations of the exposure pathways associated with potential future risk after the remedial actions.
Potential environmental impacts of remedial action	Natural attenuation would slowly reduce COC mass, but amount of reduction would remain unknown.	Excavation activities will temporarily impact nearby residents due to noise and roadway traffic.	Soil mixing and excavation activities will temporarily impact nearby residents due to noise and roadway traffic.	Excavation activities will temporarily impact nearby residents due to noise and roadway traffic.
Reduction of Toxicity, Mobility, or Volume Through Treatment				
Treatment processes used and materials treated	None.	Acceptable. Treatment processes will be utilized to reduce VOC concentrations in groundwater and soil.	Acceptable. Treatment processes will be utilized to reduce VOC concentrations in groundwater and soil.	None.
Amount of hazardous material destroyed or treated	Natural attenuation slowly would reduce concentrations of COCs in the groundwater over time, but amount of reduction would remain unknown.	Most mass would be destroyed or treated. Natural attenuation would slowly reduce concentrations of COCs in the groundwater over time. Potentially hazardous material pertaining to VOCs would be treated in soil and groundwater. Sampling would evaluate the amount of reduction.	Most mass would be destroyed or treated. Natural attenuation would slowly reduce concentrations of COCs in the groundwater over time. Potentially hazardous material pertaining to VOCs would be treated in soil and groundwater. Sampling would evaluate the amount of reduction.	Most mass would be removed from the site. Natural attenuation would slowly reduce concentrations of COCs in the groundwater over time.
Expected reduction in toxicity, mobility, or volume of the waste	Little. Natural attenuation would slowly reduce VOC mass, but amount of reduction would remain unknown.	Significant. Natural attenuation would slowly reduce VOC mass and treatment would reduce VOC mass in Plume A TTZ.	Significant. Natural attenuation would slowly reduce VOC mass and treatment would reduce VOC mass in Plume A TTZ.	Significant. Natural attenuation would slowly reduce VOC mass.
Irreversibility of treatment	Not applicable.	Complete. Once VOCs are degraded, they will not recur.	Complete. Once VOCs are degraded, they will not recur.	Not applicable.

TABLE 2-21
Detailed Evaluation of Remedial Alternatives
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Evaluation Criteria	Alternative 1 No Action	Alternative 2 In Situ Groundwater Treatment Using Thermal Technologies, Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 3 In Situ Groundwater Treatment and Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 4 Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal and Offsite Disposal
Type and quantity of residuals that will remain following treatment	Not applicable.	Ultimately no treatment residuals will remain. Concentrations of VOC daughter products such as vinyl chloride may be generated, but vinyl chloride is expected to biodegrade and not accumulate. Monitoring will evaluate the residuals.	Ultimately no treatment residuals will remain. Concentrations of VOC daughter products such as vinyl chloride may be generated, but vinyl chloride is expected to biodegrade and not accumulate. Monitoring will evaluate the residuals.	Not applicable.
Statutory preference for treatment	Does not satisfy.	Meets preference for treatment.	Meets preference for treatment.	Does not satisfy.
Short-Term Effectiveness				
Protection of workers during remedial action	Not applicable.	Treatment is not expected to create additional risk to industrial workers onsite because of the proximity of workers to the TTZ. Workers implementing the remedy would have limited potential for exposure to PCE, since remediation-derived waste may be generated only as part of monitoring well installation and abandonment activities. The surface soil removal activities were based on residential exposure risk, not industrial workers. Risks associated with heavy machinery use and with intrusive activities on the environment during the remedial action will be addressed through safe work practices and a comprehensive health and safety plan.	Treatment is not expected to create additional risk to industrial workers onsite. Workers implementing the remedy would have potential exposure to PCE, since soil mixing will expose most of the PCE within the TTZ. Risk associated with surface soil removal was based on exposure of residents, not industrial workers. Risks associated with heavy machinery use and with intrusive activities on the environment during the remedial action will be addressed through safe work practices and a comprehensive health and safety plan.	Removal activities are not expected to pose additional risk to industrial workers onsite. Workers implementing the remedy could be exposed to PCE, since excavation and removal would expose the PCE within the TTZ. Risk associated with surface soil removal was based on exposure of residents, not industrial workers. Risks associated with heavy machinery use and with intrusive activities on the environment during the remedial action will be addressed through safe work practices and a comprehensive health and safety plan.

TABLE 2-21
Detailed Evaluation of Remedial Alternatives
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Evaluation Criteria	Alternative 1 No Action	Alternative 2 In Situ Groundwater Treatment Using Thermal Technologies, Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 3 In Situ Groundwater Treatment and Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 4 Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal and Offsite Disposal
Protection of the community during remedial action	Not applicable.	Implementation of the groundwater TTZ alternative would have little (if any) impact to the community. Excavation and removal work associated surface soil remediation may affect the community by trucks entering and leaving the site.	Implementation of the groundwater TTZ alternative would have little (if any) impact to the community. Excavation and removal work associated surface soil remediation may affect the community by trucks entering and leaving the site.	Excavation and removal work associated with surface soil and groundwater TTZ remediation may affect the community by trucks entering and leaving the site. This alternative would have more trucks entering and leaving the site.
Potential environmental impacts of remedial action	Not applicable.	Treatment would introduce minimal impacts due to construction work, such as excavation and transportation of surface soil.	Treatment would introduce minimal impacts due to construction work, such as excavation and transportation of surface soil.	Treatment would introduce impacts from construction work, such as excavation and transportation of surface and subsurface soil.
Time until protection is achieved	Protection is not achieved.	Due to the existing ordinance and depth to groundwater, protection would be achieved rapidly onsite. Groundwater contamination under Stratford Avenue would not be addressed during the remedial action, therefore protection would not be achieved rapidly offsite.	Due to the existing ordinance and depth to groundwater, protection would be achieved rapidly onsite. Groundwater contamination under Stratford Avenue would not be addressed during the remedial action, therefore protection would not be achieved rapidly offsite.	Due to the existing ordinance and depth to groundwater, protection would be achieved rapidly onsite. Groundwater contamination under Stratford Avenue would not be addressed during the remedial action, therefore protection would not be achieved rapidly offsite.
Implementability				
Technical feasibility	Not applicable.	Feasible, but complex because of thermal treatment application and its design. An additional power source would be required.	Feasible, but complex because application of the chemical reduction amendment and design would be required.	Feasible.
Reliability of technology	Not applicable.	Reliable.	Reliable.	Reliable.
Administrative feasibility	Not feasible.	Feasible.	Feasible.	Feasible.
Availability of equipment, services, and materials	Not applicable.	Additional power sources would be required to operate this remedial action.	Equipment and materials are readily available.	Equipment and materials are readily available.

TABLE 2-21
Detailed Evaluation of Remedial Alternatives
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Evaluation Criteria	Alternative 1 No Action	Alternative 2 In Situ Groundwater Treatment Using Thermal Technologies, Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 3 In Situ Groundwater Treatment and Soil and Powder Well Sediment Removal and Offsite Disposal	Alternative 4 Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal and Offsite Disposal
Cost				
Capital cost	$0	$2,638,000	$1,772,000	$1,971,000
Present worth[a]	$0	$1,116,000	$1,116,000	$1,116,000
Period of analysis (yr)	$0	50[b]	50[b]	50[b]
Capital and present worth	$0	$3,754,000[c]	$2,888,000[c]	$3,087,000[c]
Present Cost Range (-30 / +50)	$0	$2,628,000 to $5,631,000	$2,022,000 to $4,332,000	$2,161,000 to $4,631,000

[a] Present worth of periodic costs (Five-year review, operation and maintenance) are shown.

[b] Based on USEPA, 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 540-R-00-002).

[c] Cost estimate is provided in Appendix A.

TABLE 2-23
Alternative 3—In Situ Groundwater Treatment and
Soil and Powder Well Sediment Removal and Offsite Disposal
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Description	Qty	Unit	Unit Cost	Total	Source	Assumptions
Confirmation Sampling for Soil Removal Activities						
Laboratory Analysis						
Arsenic Analysis	48	EA	$25	$1,200	Vendor Quote	5 soil borings each at 2 removal areas for collection of 0-6", 6-12", 12-18", and 18-24" intervals; includes QA/QC samples.
Arsenic and Lead Analysis	24	EA	$51	$1,224	Vendor Quote	5 soil borings at 1 removal area for collection of 0-6", 6-12", 12-18", and 18-24" intervals; includes QA/QC samples.
Thallium Analysis	48	EA	$25	$1,200	Vendor Quote	5 soil borings each at 2 removal areas for collection of 0-6", 6-12", 12-18", and 18-24" intervals; includes QA/QC samples.
Lead Analysis	24	EA	$26	$624	Vendor Quote	5 soil borings at 1 removal area for collection of 0-6", 6-12", 12-18", and 18-24" intervals; includes QA/QC samples.
Aroclor 1260 Analysis	24	EA	$26	$624	Vendor Quote	5 soil borings at 1 removal area for collection of 0-6", 6-12", 12-18", and 18-24" intervals; includes QA/QC samples.
Fieldwork Expenses						
Labor	1	LS	$7,200	$7,200	Engineer's Estimate	Fieldwork, office support.
Equipment	1	LS	$725	$725	Engineer's Estimate	Sampling and health and safety equipment.
Travel	1	LS	$288	$288	Engineer's Estimate	Assumes 3 days to complete surface soil delineation.
Subtotal				**$13,085**		
Excavation/Backfill/Transport and Disposal of Soil and Sediment						
Site Preparation						
Preparation	1	LS	$6,540	$6,540	Engineer's Estimate	Subcontractor labor, backhoe, 10-wheel dump truck, private utility locate.
Laboratory Analysis						
Waste Characterization	7	EA	$900	$6,300	Engineer's Estimate	Characterization of soil at each removal area for offsite disposal, sample technician, equipment, and supplies.
Excavation						
Soil Excavation - Arsenic and Lead	245	CY	$70	$17,150	Engineer's Estimate	Arsenic and lead excavation dimensions: 475 sf x 1'; 1,125 sf x 2'; 1,210 sf x 2'; and 1340 sf x 1'
Soil Excavation - Thallium	155	CY	$70	$10,850	Engineer's Estimate	Thallium excavation dimensions: 915 sf x 2' and 1,175 sf x 2'
Soil Excavation - Aroclor 1260	65	CY	$70	$4,550	Engineer's Estimate	Aroclor 1,260 excavation dimension: 875 sf x 2'
IDW Management						
Transportation & Disposal-Special Waste (conversion factor 1.7)	160	TN	$72	$11,520	Engineer's Estimate	Assumes 20% of soil IDW is special waste.
Transportation & Disposal-Hazardous (conversion factor 1.7)	474	TN	$278	$131,772	Engineer's Estimate	Assumes 60% of soil IDW is hazardous.
Transportation & Disposal-Hazardous Pre-treat (conversion factor 1.7)	160	TN	$422	$67,520	Engineer's Estimate	Assumes 20% of soil IDW is hazardous requiring pre-treatment.
Restoration						
Backfill with Imported Fill (conversion factor of 1.6)	744	TN	$41	$30,504	Engineer's Estimate	Subcontractor labor, compactor, backhoe, 10-wheel dump truck.
Seeding and straw	7,115	SF	$0.15	$1,067	Engineer's Estimate	Standard grass seed.

TABLE 2-23
Alternative 3—In Situ Groundwater Treatment and
Soil and Powder Well Sediment Removal and Offsite Disposal
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Description	Qty	Unit	Unit Cost	Total	Source	Assumptions
Watering	1	LS	$22,660	$22,660	Engineer's Estimate	Daily watering for 6 weeks - includes water truck services.
Survey Support						
Surveying of Excavation Extents	1	LS	$2,200	$2,200	Vendor Quote	Includes survey of 4 corners at 7 removal areas, data evaluation and report.
Air Monitoring						
Air Monitoring	10	DY	$29	$290	Engineer's Estimate	Breathing zone monitoring during excavation activities.
Fieldwork Expenses						
Labor	1	LS	$10,000	$10,000	Engineer's Estimate	Fieldwork and office support.
Equipment	1	LS	$300	$300	Engineer's Estimate	Sampling and health and safety equipment.
Travel	1	LS	$950	$950	Engineer's Estimate	Assumes 2 weeks to complete surface soil removal and backfill.
Subtotal				**$324,173**		
Powder Well Sediment Removal						
Sediment Removal						
Sediment Removal Services	28	CY	$174	$4,872	Vendor Quote	Removal of 28 yd^3 of sediment from 22 powder wells via vacuum truck.
IDW Management						
Transportation and Disposal - Special Waste (conversion factor of 1.29 for sediment)	18	TN	$70	$1,260	Engineer's Estimate	Disposal of 36 tons of sediment as 50% as special waste.
Transportation and Disposal - Hazardous (conversion factor of 1.29 for sediment)	18	TN	$270	$4,860	Engineer's Estimate	Disposal of 36 tons of sediment as 50% hazardous.
Laboratory Analysis						
Waste Characterization	1	LS	$2,283	$2,283	Vendor Quote	
Fieldwork Expenses						
Labor	1	LS	$6,000	$6,000	Engineer's Estimate	Fieldwork, office support.
Travel Expenses	1	LS	$318	$318	Engineer's Estimate	
Equipment	1	LS	$725	$725	Engineer's Estimate	
Air Monitoring						
Air Monitoring	3	DY	$29	$87	Engineer's Estimate	Breathing zone monitoring during sediment removal activities.
Subtotal				**$20,405**		
Pre-Remedial Design Sampling						
Installation of Groundwater Sampling Points						
Drilling Services	1	LS	$9,500	$9,500	Vendor Quote	Installation of 7 temporary wells, abandonment, drums, mobilization.
Laboratory Analysis						
Analysis of COCs	11	EA	$60	$660	Vendor Quote	Analysis of PCE; includes QA/QC.
Waste Characterization	2	EA	$289	$578	Vendor Quote	
IDW Management						
Transportation and Offsite Disposal	1	LS	$1,700	$1,700	Vendor Quote	Offsite disposal of 4 soil drums. Liquid IDW discharged via sanitary sewer system.
Fieldwork Expenses						
Labor	1	LS	$7,600	$7,600	Engineer's Estimate	Fieldwork, office support, and data validation.
Equipment	1	LS	$1,375	$1,375	Engineer's Estimate	Sampling and health and safety equipment.
Travel Expenses	1	LS	$318	$318	Engineer's Estimate	Assumes 3 days to complete groundwater delineation.

TABLE 2-23
Alternative 3—In Situ Groundwater Treatment and
Soil and Powder Well Sediment Removal and Offsite Disposal
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Description	Qty	Unit	Unit Cost	Total	Source	Assumptions
Survey Support						
Survey of Sample Locations	1	LS	$1,630	$1,630	Vendor Quote	Includes survey of 7 groundwater sample points, data evaluation and report.
Subtotal				**$23,361**		
Well Abandonment / Installation						
Well Abandonment and Installation at Plumes A and C						
Abandonment and Installation Services	1	LS	$9,370	$9,370	Vendor Quote	Abandonment of 4 shallow 2" well (MW-105, MW-106, MW-114, MW-111) and 1 deep well (MW-117), and installation of 3 shallow 2" wells (2 at Plume A and 1 at Plume C); includes well development, drums, and mobilization.
IDW Management						
Transportation and Offsite Disposal	1	LS	$4,400	$4,400	Vendor Quote	Offsite disposal of 12 soil drums and discharge of liquid IDW via sanitary sewer system.
Fieldwork Expenses						
Labor	1	LS	$9,200	$9,200	Engineer's Estimate	Fieldwork and office support.
Equipment and Supplies	1	LS	$725	$725	Engineer's Estimate	
Travel Expenses	1	LS	$404	$404	Engineer's Estimate	Assumes 4 days to complete abandonment/installation activities.
Survey Support						
Survey of New Wells	1	LS	$1,470	$1,470	Vendor Quote	Includes survey of 3 wells, data evaluation and report.
Subtotal				**$25,569**		
Soil Mixing at Plume A						
Implementation						
Subcontractor Mobilization and Demobilization	1	LS	$130,000	$130,000	Vendor Quote	Treatment Area: 2,100 ft^2 Target Treatment Zone: 1-29 feet bgs
Chemical Reduction Product	1	LS	$57,750	$57,750	Vendor Quote	Treatment Zone Volume: 59,000 ft^3 mass of product required: 36,450
Enhanced Reductive Dechlorination Product	1	LS	$24,750	$24,750	Vendor Quote	lbs, Includes the following: 40' x 40'
Preparation						concrete pad removal, 1-pass
Soil Mixing	1	LS	$300,000	$300,000	Vendor Quote	trenching machine,
Chemical Application	1	LS	$32,850	$32,850	Vendor Quote	decontamination pad, IDW disposal,
Decontamination of Equipment	1	LS	$12,500	$12,500	Vendor Quote	mobilization / demobilization,
IDW Management of Excess Soil	1	LS	$10,425	$10,425	Vendor Quote	installation of sediment and erosion control, placement of topsoil over disturbed areas, seeding, fertilizer,
Sewer Line Removal	1	LS	$2,000	$2,000	Engineer's Estimate	and straw, daily watering for 6 weeks, and site clean-up.
Site Restoration	1	LS	$20,960	$20,960	Vendor Quote	
Project Management	1	LS	$4,600	$4,600	Vendor Quote	
Fieldwork Expenses						
Labor	1	LS	$20,480	$20,480	Engineer's Estimate	Fieldwork, office support.
Equipment	1	LS	$1,500	$1,500	Engineer's Estimate	Sampling and health and safety equipment.
Travel	1	LS	$1,390	$1,390	Engineer's Estimate	Assumes 4 weeks to complete soil mixing.
Subtotal				**$619,205**		

TABLE 2-23
Alternative 3—In Situ Groundwater Treatment and
Soil and Powder Well Sediment Removal and Offsite Disposal
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Description	Qty	Unit	Unit Cost	Total	Source	Assumptions
Groundwater Monitoring at Plume A - 2 Events						
Groundwater Monitoring at Plume A						
Laboratory Analysis						
Analysis of COCs	2	EA	$60	$120	Vendor Quote	2 monitoring wells within Plume A to be sampled approximately one month following soil mixing activities (will coincide with the first annual groundwater monitoring event). The second event will occur 12 weeks later.
Soil and Liquid IDW Characterization	1	EA	$289	$289	Vendor Quote	1 Liquid IDW sample/event.
IDW Management						
Transportation and Disposal	1	LS	$2,210	$2,210	Vendor Quote	Disposal of 1 liquid IDW drum via sanitary sewer system/event.
Fieldwork Expenses						
Labor	1	LS	$5,000	$5,000	Engineer's Estimate	Fieldwork, office support, project management.
Equipment	1	LS	$808	$808	Engineer's Estimate	Sampling and health and safety equipment.
Travel	1	LS	$318	$318	Engineer's Estimate	Assumes 4-day rentals to complete soil sampling/event.
Subtotal				**$8,745**		
Remedial Design			6%	**$62,073**		
Work Planning			6%	**$62,073**		
Contingency			25%	**$258,636**		
Subtotal				**$382,781**		
Total Cost of Alternative 3 with Remedial Design and Contingency				**$1,417,324**		
Construction Oversight/Project Management			10%	**$141,732**		
Reporting (Includes RACR and Annual LTM Report)			15%	**$212,599**		
Subtotal				**$354,331**		
TOTAL CAPITAL COST				**$1,771,655**		
Groundwater Monitoring at Plumes A and C - Years 1 and 2						
Laboratory Analysis						
Analysis of COCs	68	EA	$60	$4,080	Vendor Quote	11 monitoring wells sampled per quarterly event for a period of 2 years; includes QA/QC. Annual costs are presented.
Waste Characterization	1	EA	$1,156	$1,156	Vendor Quote	
IDW Management						
Transportation and Disposal	1	EA	$800	$800	Vendor Quote	Disposal of liquid IDW via sanitary sewer system.
Fieldwork Expenses						
Labor	1	EA	$16,000	$16,000	Engineer's Estimate	Fieldwork, office support, data validation for 4 quarterly events.
Equipment and Supplies	1	EA	$2,638	$2,638	Engineer's Estimate	Sampling and health and safety equipment for 4 quarterly events.
Travel Expenses	1	EA	$436	$436	Engineer's Estimate	Assumes 1 day to complete groundwater sampling activities. Costs reflect 4 quarterly events.

TABLE 2-23
Alternative 3—In Situ Groundwater Treatment and
Soil and Powder Well Sediment Removal and Offsite Disposal
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Description	Qty	Unit	Unit Cost	Total	Source	Assumptions
Reporting						
Groundwater Monitoring and Inspection Report	1	LS	$12,000	$12,000	Engineer's Estimate	
Data Management	1	LS	$2,400	$2,400	Engineer's Estimate	
Subtotal				**$39,510**		
Contingency			30%	**$11,853**		
Subtotal				**$51,363**		
Project Management			10%	**$5,136**		
Technical Support			20%	**$10,273**		
Total Annual Groundwater Monitoring Cost - Years 1 and 2				**$66,772**		
Groundwater Monitoring at Plumes A and C - Years 3 through 50						
Laboratory Analysis						
Analysis of COCs	17	EA	$60	$1,020	Vendor Quote	11 monitoring wells sampled annually; includes QA/QC.
Waste Characterization	1	EA	$289	$289	Vendor Quote	
IDW Management						
Transportation and Disposal	1	LS	$800	$800	Vendor Quote	Disposal of liquid IDW via sanitary sewer system.
Fieldwork Expenses						
Labor	1	LS	$4,000	$4,000	Engineer's Estimate	Fieldwork, office support, data validation per event.
Equipment	1	LS	$633	$633	Engineer's Estimate	Sampling and health and safety equipment.
Travel Expenses	1	LS	$109	$109	Engineer's Estimate	Assumes 1 day to complete groundwater sampling activities.
Reporting						
Groundwater Monitoring and Inspection Report	1	LS	$12,000	$12,000	Engineer's Estimate	
Data Management	1	LS	$2,400	$2,400	Engineer's Estimate	
Subtotal				**$21,251**		
Contingency			30%	**$6,375**		
Subtotal				**$27,626**		
Project Management			10%	**$2,763**		
Technical Support			20%	**$5,525**		
Subtotal				**$8,288**		
Total Annual Groundwater Monitoring Cost - Years 3 through 50				**$35,914**		
Periodic Costs - Five-year Reviews - Years 5 through 50						
5-year Review	LS	1	$15,000	$15,000	Engineer's Estimate	
Periodic Costs Per Five-year Review - Years 5 through 50				**$15,000**		
			2.7%	Discount Rate		
			0.0%	Inflation Rate		
Present Value Analysis						
Present Worth of GW Monitoring - Years 1 and 2			1.9218	$128,324		
Present Worth of GW Monitoring - Years 3 through 50			25.3403	$910,076		
Present Worth of Periodic Costs in Year 5			0.8753	$13,129		
Present Worth of Periodic Costs in Year 10			0.7661	$11,492		
Present Worth of Periodic Costs in Year 15			0.6706	$10,059		
Present Worth of Periodic Costs in Year 20			0.5869	$8,804		
Present Worth of Periodic Costs in Year 25			0.5137	$7,706		
Present Worth of Periodic Costs in Year 30			0.4497	$6,745		
Present Worth of Periodic Costs in Year 35			0.3936	$5,904		
Present Worth of Periodic Costs in Year 40			0.3445	$5,167		
Present Worth of Periodic Costs in Year 45			0.3015	$4,523		
Present Worth of Periodic Costs in Year 50			0.2639	$3,959		
Total Present Worth Costs				**$1,115,887**		
TOTAL CAPITAL AND PRESENT WORTH COSTS				**$2,887,542**		

TABLE 2-23
Alternative 3—In Situ Groundwater Treatment and
Soil and Powder Well Sediment Removal and Offsite Disposal
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Description	Qty	Unit	Unit Cost	Total	Source	Assumptions

Note:

1) The estimate above is considered budgetary-level cost estimating, suitable for use in project evaluation and planning. Actual construction costs are expected to vary from these estimates due to market conditions, actual costs of purchased materials, quantity variations, regulatory requirements, and other factors existing at the time of construction.

2) Costs were based on RS Means (2005 edition using a 4% annual increase to 2010), MRK Exploration quote, Environmental Works quote, Summit quote, Capitol Environmental 2008 quote, Ferguson Surveying 2008 quote, PEL 2008 quote, and Engineer's Estimates. Costs are based on present worth. Escalation assumptions were not included in costs.

3) Excavation costs were based on RS Means (2005 edition using a 3% annual increase to 2010). Costs are based on present worth. Escalation assumptions were not included in costs.

4) *Mobilization/Demobilization* costs will include site setup, facilities, utility location, signage, security, decon cell, dust suppression, site teardown/restoration, and demobilization.

5) *Construction Oversight/Project Management* costs include daily oversight, health and safety requirements, project management requirements, subcontractor procurements, and any day to day requirements deemed necessary.

6) *Reporting* costs include development of the work plan and other required planning documents including but not limited to quality control, health and safety, environmental protection, and completion reporting (as-built drawings).

Abbreviations and Acronyms:

EA - Each
LS - Lump Sum
QA/QC - Quality Assurance/Quality control
CY - Cubic Yard
TN - Ton
IDW - Investigation-derived waste
MW - Monitoring Well
PCE - Tetrachloroethene
TCE - Trichloroethene
1,1,1,2-TeCA - 1,1,1,2-tetrachloroethane
1,1,2,2-TeCA - 1,1,2,2-tetrachloroethane

TABLE 2-23

Remediation Goals for Chemicals of Concern

Decision Document

St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Chemical	Cleanup Level	Units	Basis for Cleanup Level
Soil Remediation Goals			
Antimony	31	mg/kg	Regional Screening Level [a] for Residential Soil based on a Noncancer Hazard Index of 1.0
Aroclor 1260 [b]	1	mg/kg	"To be Considered" ARAR (40 CFR 761.61(a)(4)(I)(A))
Arsenic [b]	13.2	mg/kg	Site-specific background value [c]
Lead [b]	400	mg/kg	Regional Screening Level [a] for Residential Soil based on a Noncancer Hazard Index of 1.0
Thallium	7	mg/kg	Regional Screening Level [a] for Residential Soil based on a Noncancer Hazard Index of 1.0
Groundwater Remediation Goals			
CT	3,200	µg/L	Construction Worker Dermal Contact with Excavation Water based on ELCR of 1×10^{-5} and HI of 1.0
PCE	21,000	µg/L	Construction Worker Dermal Contact with Excavation Water based on ELCR of 1×10^{-5} and HI of 1.0
Migration from Soil to Groundwater			
CT [d]	1.19	mg/kg	Site-specific calculations [e]
PCE [d]	9.14	mg/kg	Site-specific calculations [f]

[a] U.S. Environmental Protection Agency. 2009. USEPA Regional Screening Levels. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables /index.htm.

[b] Although remediation goals were developed for arsenic, lead, and Aroclor 1260, the HHRA did not identify those chemicals as COCs. Elevated concentrations of arsenic, lead, and Aroclor 1260 had been excluded from the HHRA, because project stakeholders agreed that areas where these chemical concentrations were elevated would be addressed through a future soil removal action. Remediation goals for arsenic, lead, and Aroclor 1260 will serve as cleanup criteria when the Army performs the removal action. Because the remaining concentrations do not pose unacceptable risk to human health, arsenic, lead, and Aroclor 1260 do not require additional remedial action beyond the soil removal areas previously identified.

[c] Maximum-likelihood-estimate 95/95 upper tolerance limit of onsite arsenic concentrations, after the removal of outliers from the sample population

[d] Although CT and PCE were not identified as soil COCs in the HHRA, their concentrations in soil may affect the RAO for construction worker dermal contact with groundwater. Therefore, remediation goals were developed for unsaturated soil to address potential ongoing sources of groundwater contamination.

[e] Site-specific calculations based on groundwater remediation goal of 3,200 µg/kg for CT and dilution attenuation factor of 1

[f] Site-specific calculations based on groundwater remediation goal of 21,000 µg/kg or PCE and dilution attenuation factor of 1

CT = carbon tetrachloride

PCE = tetrachloroethylene

ELCR = excess lifetime cancer risk

HHRA = human health risk assessment

HI = hazard index

TABLE 2-24
Applicable, Relevant, and Appropriate Requirements
Decision Document
St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Requirement	Requirement Synopsis
Federal	
Clean Air Act (42 U.S.C. 7401 et seq.)	The Clean Air Act is intended to protect the quality of air and promote public health. Title I of the Act directed the USEPA to publish national ambient air quality standards for "criteria pollutants." In addition, USEPA has provided national emission standards for hazardous air pollutants under Title III of the Clean Air Act. Hazardous air pollutants are also designated hazardous substances under CERCLA. The Clean Air Act amendments of 1990 greatly expanded the role of National Emission Standards for Hazardous Air Pollutants by designating 179 new hazardous air pollutants and directed USEPA to attain maximum achievable control technology standards for emission sources. Such emission standards are potential ARARs if selected remedial technologies (such as incinerators or air strippers) produce air emissions of regulated hazardous air pollutants. Substantive criteria promulgated pursuant to the Clean Air Act may be considered an ARAR for remedies that involve creation of air emissions, such as excavation activities that might create dust or treatment systems that might emit VOCs.
Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 321 et seq.)	RCRA was passed in 1976. It amended the Solid Waste Disposal Act by including provisions for hazardous waste management. The goals of RCRA are to promote conservation of natural resources while protecting human health and the environment. The statute sets out to control the management of hazardous waste from inception to ultimate disposal. RCRA is linked closely with CERCLA, and the CERCLA list of hazardous substances includes all RCRA hazardous wastes. The Act applies only if soils are considered a hazardous waste. Soils are required to be managed as hazardous waste if they contain listed hazardous waste or have the characteristics of hazardous waste.
State	
Missouri Air Conservation Law	The Air Conservation Law in its present form was passed in 1986. It assigned the Missouri Air Conservation Commission to the authority of the MDNR's Air and Land Protection Division. The law is an ARAR for remedies that involve creation of air emissions, such as excavation activities that have the potential to create dust.
Departmental Missouri Risk-Based Corrective Action (MRBCA) Technical Guidance (April 2006)	The guidance is to provide a framework for cleanup decisions that facilitate the constructive use of contaminated sites by protecting human health and the environment in the context of current and future site use. This guidance applies to contaminated or potentially contaminated sites and provides a methodology to conduct site-specific characterization; calculate risk-based levels protective of human health, public welfare and the environment; and implement appropriate risk management activities, including long-term stewardship requirements. The guidance document provides a tool for developing cleanup levels. It is a requirement "to be considered" because it is a state guidance document rather than a promulgated requirement.

N

0 300 600

Feet

LEGEND

Site Boundary

FIGURE 2-1
SITE LOCATION MAP
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-1_SITE_LOC_DD.MXD MSCHROCK 11/29/2010 20:41:30

Job Corps Dormitory
223 B

Transformer Station
244

MW-115
MW-118
MW-113
MW-109
MW-114
MW-111
MW-117
MW-110
MW-106
MW-108
MW-116
MW-112
MW-107
MW-105
MW-104
MW-102
MW-103

PW25
PW4
PW5
PW3
PW6
PW1
PW7
PW2
PW8
PW9
PW10
PW11
PW12
PW13
PW14
PW15
PW16
PW17
PW18
PW19
PW20
PW21
PW22

Job Corps
Gymnasium

Guard
House

Tunnel
Access

Tunnel
Access

GOODFELLOW BLVD

STRATFORD AVE

Aerial Photo: 2007 Google Earth

LEGEND

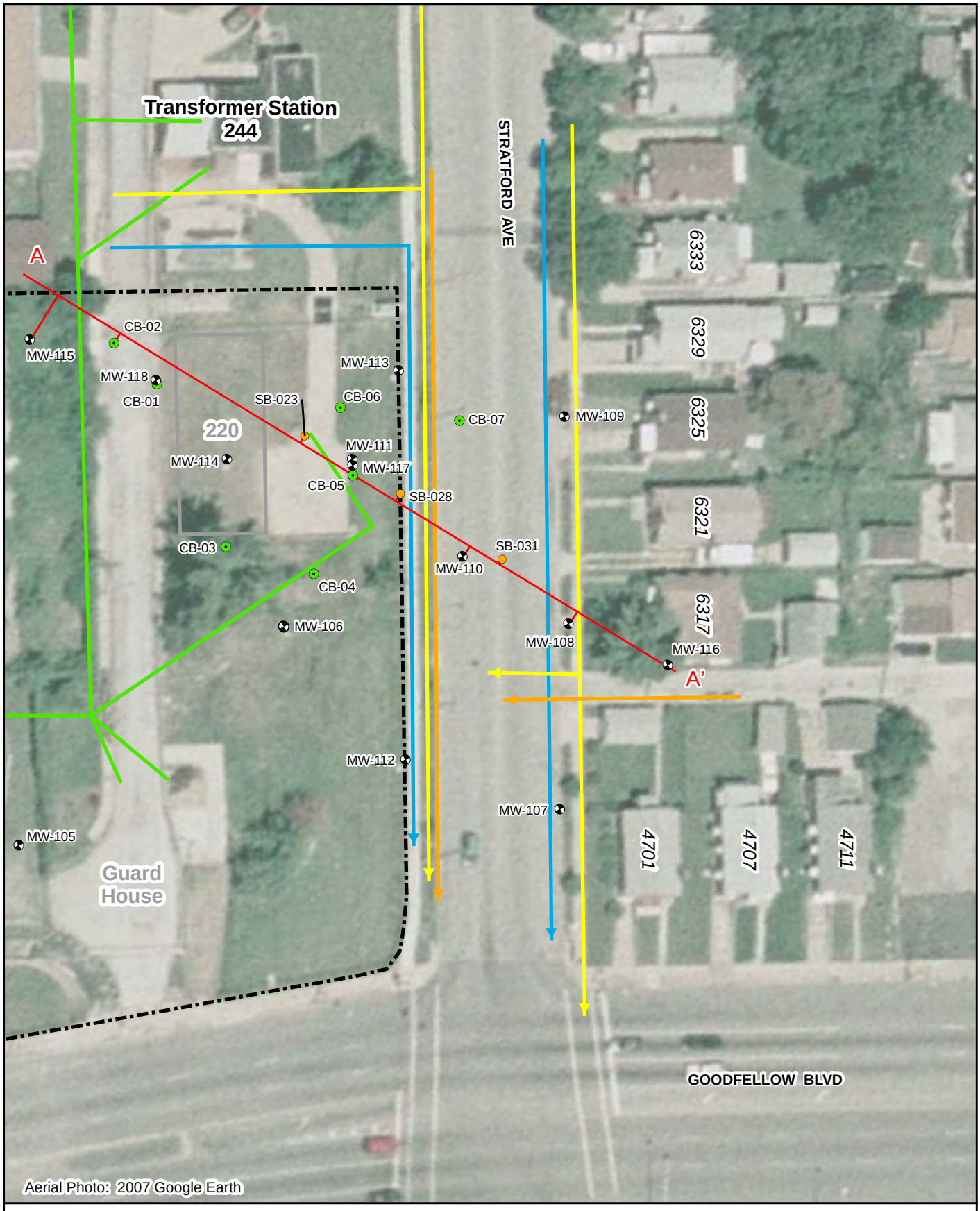
- Monitoring Well
- Powder Well
- Elevation Contour (2-foot interval)
- Site Boundary
- 220 Former Building

0 50 100 Feet

FIGURE 2-2
CURRENT SITE FEATURES
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-2_SITE_FEATURES_DD.MXD MSCHROCK 11/29/2010 20:42:52



LEGEND

- Soil Boring
- Confirmation Boring
- Monitoring Well
- Cross Section
- Site Boundary
- 220 Former Building

Approximate Utilities

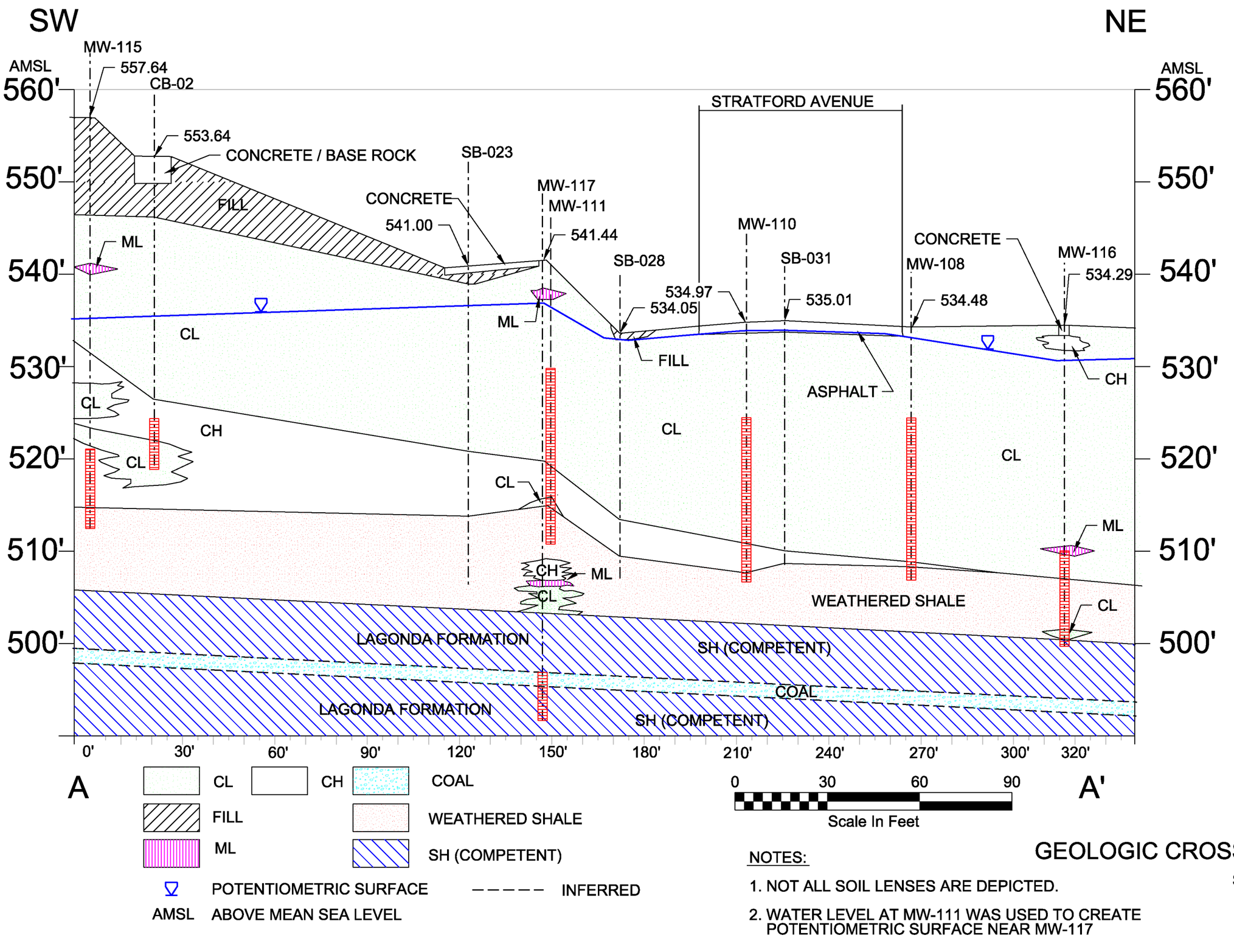
- Natural Gas
- Sanitary Sewer
- Telephone
- Water

0 30 60 Feet

FIGURE 2-3
LOCATION OF CROSS-SECTION A-A'
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-3_CROSSECTION_A_A_DD.MXD MSCHROCK 12/2/2010 13:19:27

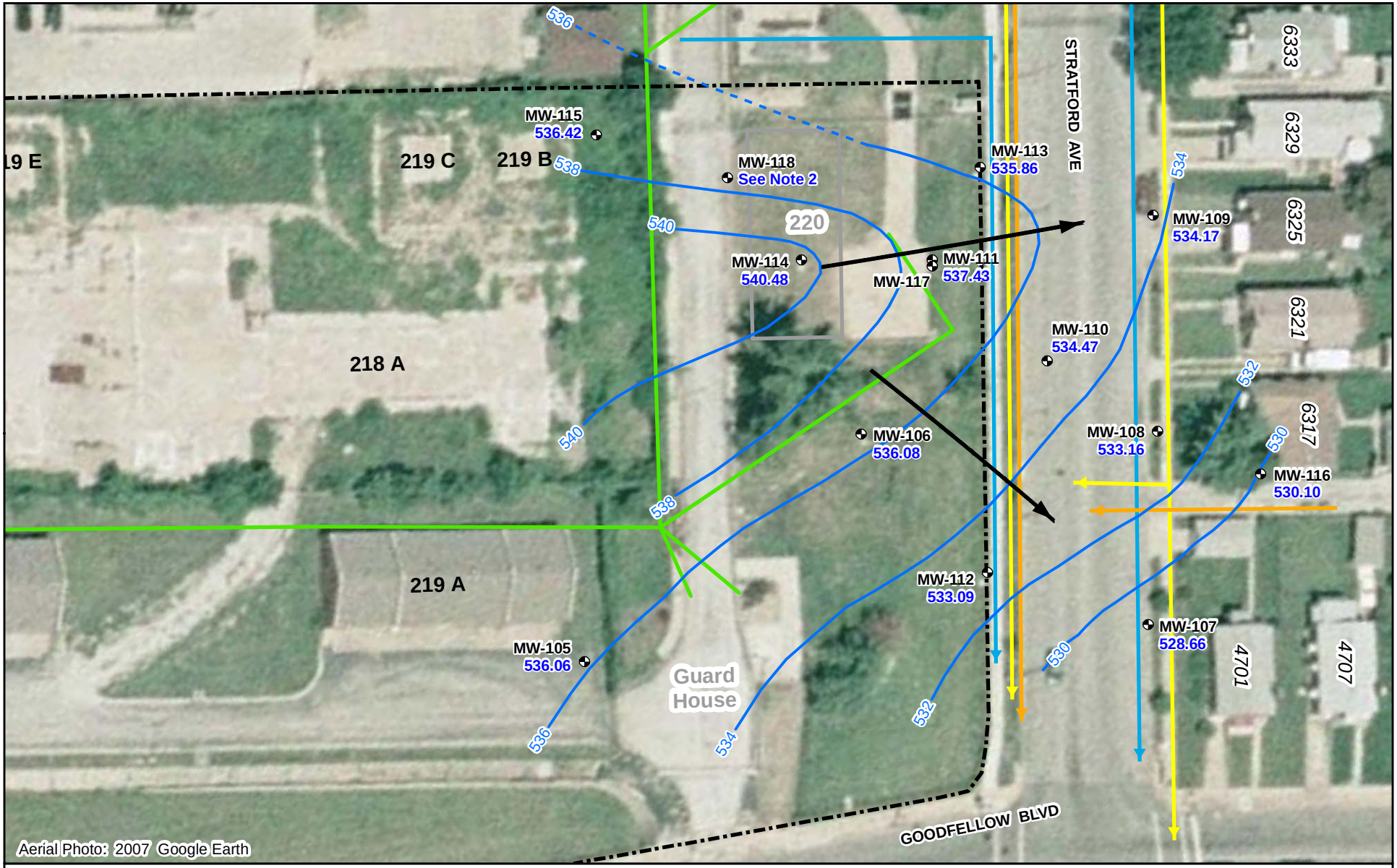


NOTES:

1. NOT ALL SOIL LENSES ARE DEPICTED.
2. WATER LEVEL AT MW-111 WAS USED TO CREATE POTENTIOMETRIC SURFACE NEAR MW-117

FIGURE 2-4
GEOLOGIC CROSS - SECTION A-A'

St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri



LEGEND

- Monitoring Well with Groundwater Elevation
- Groundwater Flow Direction
- Potentiometric Surface Contour
- 220 Former Building
- Site Boundary
- Approximate Utilities
  - Natural Gas
  - Sanitary Sewer
  - Telephone
  - Water

0 30 60 Feet

NOTE:
1. Water level measurements were collected on June 2, 2008.
2. MW-118 was not installed in 2008 when water levels were measured.

FIGURE 2-5
POTENTIOMETRIC SURFACE MAP
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-5_POT_SURF_DD.MXD MSCHROCK 11/29/2010 20:47:16

SS-228YZ-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	610
Selenium	12.4 J

SB-003	
Analyte	Results
Metals (mg/kg)	
Antimony	5.3

SS44B	
1 - 2 ft bgs	
Analyte	Results
Metals (mg/kg)	
Chromium	57.7

SS-218C-2	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	445

NS02A	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	14.5

NS03	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	44
Lead	5,840
1 - 2 ft bgs	
Arsenic	15.9

SS-219E	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	23.5
Thallium	4.52 J

CSS-015	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	13

NS08	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	67.7
1 - 2 ft bgs	
Arsenic	16.7

SS-219B	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Antimony	6.90
Arsenic	108

SS-228C-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	13.6

SB-006	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	13.3

SS-227J-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	4.66 J

PW12	
7 - 8 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	3.62 J

SS-219H-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	2.18 J

SS-219J-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	1,118
Antimony	5.73 J

HA-05	
0- 2 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	36.3

HA-06	
0- 2 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	18.2

NS05B	
1 - 2 ft bgs	
Analyte	Results
Metals (mg/kg)	
Silver	82.6

SS-220-4G	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	2.23 J

SS-220-3G	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	510
Selenium	5.65 J

CSS-001	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	1,023

SS-228B-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Antimony	3.15 J
Arsenic	16.5
Lead	1,416

SS-228A-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	18.9

SS-228E-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	13.7 J

SS-227O-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Antimony	14.1
Arsenic	16.5

SS-227B-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Antimony	4.24 J

SS-227M-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	5.07 J

SS-218C-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	2.74

SB-010	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	983

PW13	
7 - 8 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	5.19 J

SS-218C-3	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	1.94

SS-236-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	14.2

SS-218A-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	8.64 J

SS-218B-2	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	5.78 J

CSS-011	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Copper	410.2

SS-218A-3	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	7.67 J

SS-219C	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	68.8
Thallium	2.64 J

NS07A	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	13.6

SS-218A-2	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Copper	2,565
Lead	2,724

SB-020	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	983.3

SS-220-1G	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Selenium	6.42 J
Thallium	2.36 J

Analyte	Screening Level
Metals (mg/kg)	
Antimony	3.1
Arsenic	13.2
Selenium	5
Silver	34
Thallium	0.7
Chromium	38
Copper	290
Lead	400

Aerial Photo: 2007 Google Earth

LEGEND

- 2008 Soil Sample
- 2005 Soil Sample
- 2001 Soil Sample
- 1998 Soil Sample Locations
- 1991 Soil Sample
- Composite Sample Portion Line
- Site Boundary
- 220 Former Building

0 50 100 Feet

NOTE:
1. J = Reported value is estimated.
2. mg/kg = milligrams per kilogram
3. ft bgs = feet below ground surface

FIGURE 2-6
METALS IN SURFACE SOIL AT CONCENTRATIONS EXCEEDING SCREENING LEVELS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-6_SURF_SOIL_METALS_EXCEED_DD.MXD MSCHROCK 11/24/2010 13:36:26

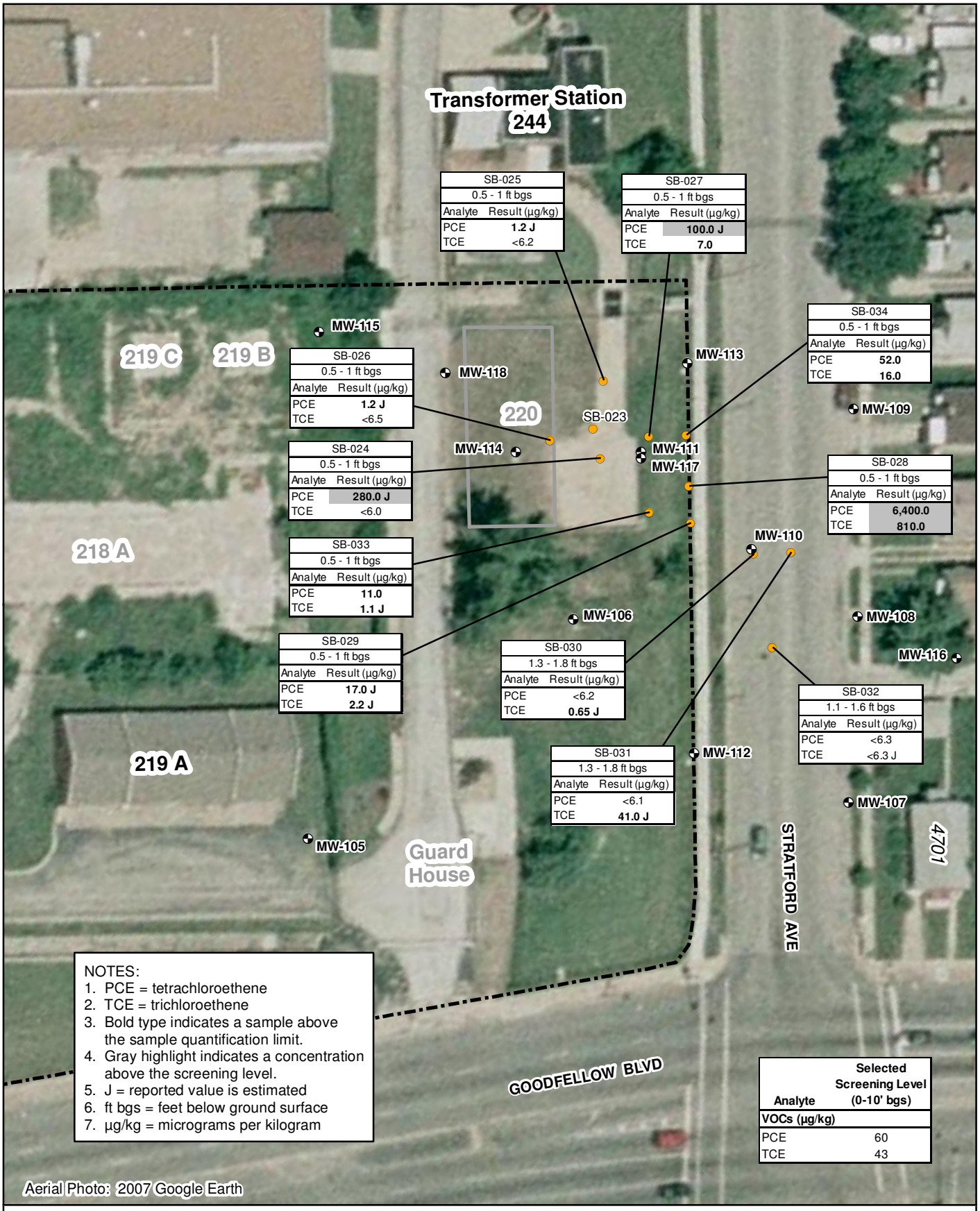


FIGURE 2-7
VOCs IN SURFACE SOIL AT CONCENTRATIONS EXCEEDING SCREENING LEVELS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-7_VOCS_SURF_SOIL_EXCEED_DD.MXD MSCHROCK 1/31/2011 11:37:45

SED-001	
0 - 1 ft bgs	
Analyte	Results
PCBs (mg/kg)	
Aroclor 1260	569

SS55A	
0 - 1 ft bgs	
Analyte	Results
PCBs (mg/kg)	
Aroclor 1260	18,200

SS-001	
0 - 1 ft bgs	
Analyte	Results
PCBs (mg/kg)	
Aroclor 1260	1.44

CSS-009	
0 - 1 ft bgs	
PAHs (µg/kg)	Results
Benzo(b)fluoranthene	766.9

SB-010	
0 - 1 ft bgs	
PAHs (µg/kg)	Results
Benzo(b)fluoranthene	818.6

SB-020	
0 - 1 ft bgs	
Analyte	Results
PAHs (µg/kg)	
Benzo(a)anthracene	245,704
Benzo(a)pyrene	196,359
Benzo(b)fluoranthene	388,878
Benzo(g,h,i)perylene	136,295
Benzo(k)fluoranthene	104,945
Chrysene	328,483
Dibenz(a,h)anthracene	30,616
Fluoranthene	797,026
Ideno(1,2,3-cd)pyrene	131,387
Pyrene	703,713

Analyte	Selected Screening Level (0-10' bgs)
PCBs (mg/kg)	
Aroclor	1[1]
PAHs/SVOCs (µg/kg)	
Benzo(a)anthracene	887
Benzo(a)pyrene	735
Benzo(b)fluoranthene	626
Benzo(g,h,i)perylene	478
Benzo(k)fluoranthene	1,500
Chrysene	15,000
Dibenz(a,h)anthracene	303
Fluoranthene	230,000*
Indeno(1,2,3-cd)pyrene	415
Pyrene	230,000*

Notes:

MSSL = USEPA Region 6 Medium-Specific Screening Levels (MSSLs) for residential land use

SSL = USEPA Region 6 Soil Screening Levels (SSLs) for protection of migration to groundwater using a dilution-attenuation factor (DAF) of 20

* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

[1] = This is the the TSCA screening level.

Aerial Photo: 2007 Google Earth

0 50 100 Feet

LEGEND

- 2008 Soil Sample
- 2005 Soil Sample
- 1998 Soil Sample Locations
- 1991 Soil Sample
- Composite Sample Portion Line
- Site Boundary
- 220 Former Building

NOTES:

1. PAH = polycyclic aromatic hydrocarbon
2. PCB = polychlorinated biphenyl
3. PCBs were analyzed in SED-001, SS55-A, and SS-001. PAHs were analyzed in all other samples shown.
4. ft bgs = feet below ground surface
5. µg/kg = microgram per kilogram
6. mg/kg = milligram per kilogram

FIGURE 2-8
PAHs AND PCBs IN SURFACE SOIL AT CONCENTRATIONS EXCEEDING SCREENING LEVELS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-8_PAHS_PCBS_SURF_SOIL_EXCEED_DD.MXD MSCHROCK 11/24/2010 14:03:42

Job Corps Dormitory
223 B

SB-023 2007						
Depth (ft bgs):	1.7 - 2.2	5 - 6	10 - 11	16 - 17	21 - 22	25 - 26
CT	<6.0	<6.4	**200.0**	**21.0**	**13.0**	**3.5 J**
Chloroform	<6.0	<6.4	**2.2 J**	**0.68 J**	**0.73 J**	<5.8
cis-1,2-DCE	**700.0**	**120.0**	**52.0**	**11.0**	**16.0**	**6.6**
PCE	**130.0 J**	**4,900**	**180,000 J**	**110,000 J**	**27,000**	**3,200,000**
TCE	**590.0**	**520.0**	**140.0**	**140.0**	**18**	**6.0**

SB-025 2007			
Depth (ft bgs):	5-6	14-15	21-22
CT	<6.3	<6.5	<6.0
Chloroform	<6.3	<6.5	<6.0
cis-1,2-DCE	<6.3	<6.5	<6.0
PCE	<6.3	**6.1 J**	<6.0
TCE	<6.3	<6.5	<6.0

CB-06 5/23/2008	
Depth (ft bgs):	21.5-22.5
CT	<2.4
Chloroform	<2.4
cis-1,2-DCE	<2.4
PCE	**2.8**
TCE	<2.4

SB-034 2007			
Depth (ft bgs):	5-6	14-15	20-21
CT	NR	NR	NR
Chloroform	NR	NR	NR
cis-1,2-DCE	**1.7 J**	**17.0**	**7.3**
PCE	**28.0**	**1,000.0 D**	**380.0 D**
TCE	**32.0**	**38.0**	**17.0**

CB-02 5/21/2008	
Depth (ft bgs):	30-30.5
CT	<2.5
Chloroform	<2.5
cis-1,2-DCE	<2.5
PCE	**1.8**
TCE	<2.5

CB-07 5/29/2008	
Depth (ft bgs):	2-3
CT	<2.7
Chloroform	<2.7
cis-1,2-DCE	<2.7
PCE	<6.8
TCE	<2.7

CB-01 5/21/2008	
Depth (ft bgs):	30-30.5
CT	**27,300 J**
Chloroform	**669**
cis-1,2-DCE	<398
PCE	<398
TCE	**5,250**

SB-028 2007			
Depth (ft bgs):	5-6	15-16	20-21
CT	<6.5	<6.2	<6.3
Chloroform	<6.5	**2.2 J**	**1.2 J**
cis-1,2-DCE	**50.0**	**160.0**	**63.0**
PCE	**780.0**	**3,500.0**	**2,300.0**
TCE	**43.0**	**110.0**	**54.0**

SB-026 2007		
Depth (ft bgs):	5-6	14-15
CT	<6.5	<6.3
Chloroform	<6.5	<6.3
cis-1,2-DCE	<6.5	<6.3
PCE	**0.46 J**	<6.3
TCE	<6.5	<6.3

SB-031 2007			
Depth (ft bgs):	5-6	14-15	21-22
CT	NR	NR	NR
Chloroform	NR	NR	NR
cis-1,2-DCE	**43.0 J**	<6.3 J	<6.1 J
PCE	**920.0 D**	**460.0 D**	**4.1 J**
TCE	**180.0 J**	**16.0 J**	**1.2 J**

SB-024 2007			
Depth (ft bgs):	5-6	16-17	21-22
CT	<6.4	<6.3	<6.1
Chloroform	<6.4	**0.47 J**	<6.1
cis-1,2-DCE	**500.0**	**140.0**	**11.0**
PCE	**19.0**	**3,500.0**	**1,100.0**
TCE	**130.0**	**61 J**	**9.3**

SB-030 2007			
Depth (ft bgs):	5-6	15-16	21-22
CT	NR	NR	NR
Chloroform	NR	NR	NR
cis-1,2-DCE	**19.0 J**	**8.4 J**	**0.95 J**
PCE	**58.0**	**2,100.0 D**	**1,000.0 D**
TCE	**42.0 J**	**14.0 J**	**11.0 J**

CB-03 5/22/2008	
Depth (ft bgs):	8-10
CT	<2.4
Chloroform	<2.4
cis-1,2-DCE	<2.4
PCE	<2.4
TCE	<2.4

SB-029 2007			
Depth (ft bgs):	5-6	15-16	20-21
CT	<6.5	<6.2	<6.1
Chloroform	<6.5	**2.2 J**	<6.1
cis-1,2-DCE	**58.0**	**100.0**	**140.0**
PCE	**48.0 J**	**550.0**	**610.0**
TCE	**31.0**	**59.0**	**66.0**

SB-027 2007			
Depth (ft bgs):	5-6	15-16	20-21
CT	<6.5	<6.3	<6.4
Chloroform	<6.5	**3.0 J**	**0.6 J**
cis-1,2-DCE	**14**	**18**	**3.6 J**
PCE	**320.0**	**8,000.0**	**2,900.0**
TCE	**52.0**	**110.0**	**20.0**

SB-032 2007			
Depth (ft bgs):	5-6	15-16	21-22
CT	NR	NR	NR
Chloroform	NR	NR	NR
cis-1,2-DCE	**3.9 J**	<6.4 J	<6.2
PCE	<6.7	**10.0**	**0.40 J**
TCE	**4.2 J**	**3.0 J**	<6.2

Analyte	Screening Level
VOCs (µg/kg)	
Carbon Tetrachloride	70
Chloroform	250
cis-1,2-DCE	400
PCE	60
TCE	43

CB-04 5/22/2008	
Depth (ft bgs):	19-20
CT	<2.4
Chloroform	<2.4
cis-1,2-DCE	<2.4
PCE	**1.8**
TCE	<2.4

CB-05 5/23/2008		
Depth (ft bgs):	4-13	13-21
CT	<115	<115
Chloroform	<115	<115
cis-1,2-DCE	**40 J**	**29.8 J**
PCE	**1,940**	**1,360**
TCE	**53.2 J**	**27.1 J**

SB-033 2007				
Depth (ft bgs):	5-6	13-14	19-20	23-24
CT	NR	NR	NR	NR
Chloroform	NR	NR	NR	NR
cis-1,2-DCE	**7.6**	**190.0 JD**	**340.0 JD**	**280.0 J**
PCE	**11.0**	**1,100.0 D**	**1,500.0 D**	**890.0 J**
TCE	**6.5**	**120.0**	**180.0 JD**	**140.0**

219 F
219 E
219 C
219 B
220
218 B
218 A
219 D
219 A
Guard House
6333
6329
6325
6321
6317
4701
4707
4711
STRATFORD AVE
GOODFELLOW BLVD

NOTE: Units are in micrograms per kilogram (µg/kg)

Aerial Photo: 2007 Google Earth

LEGEND

- Confirmation Boring
- 2007 Soil Boring
- Site Boundary
- 220 Former Building

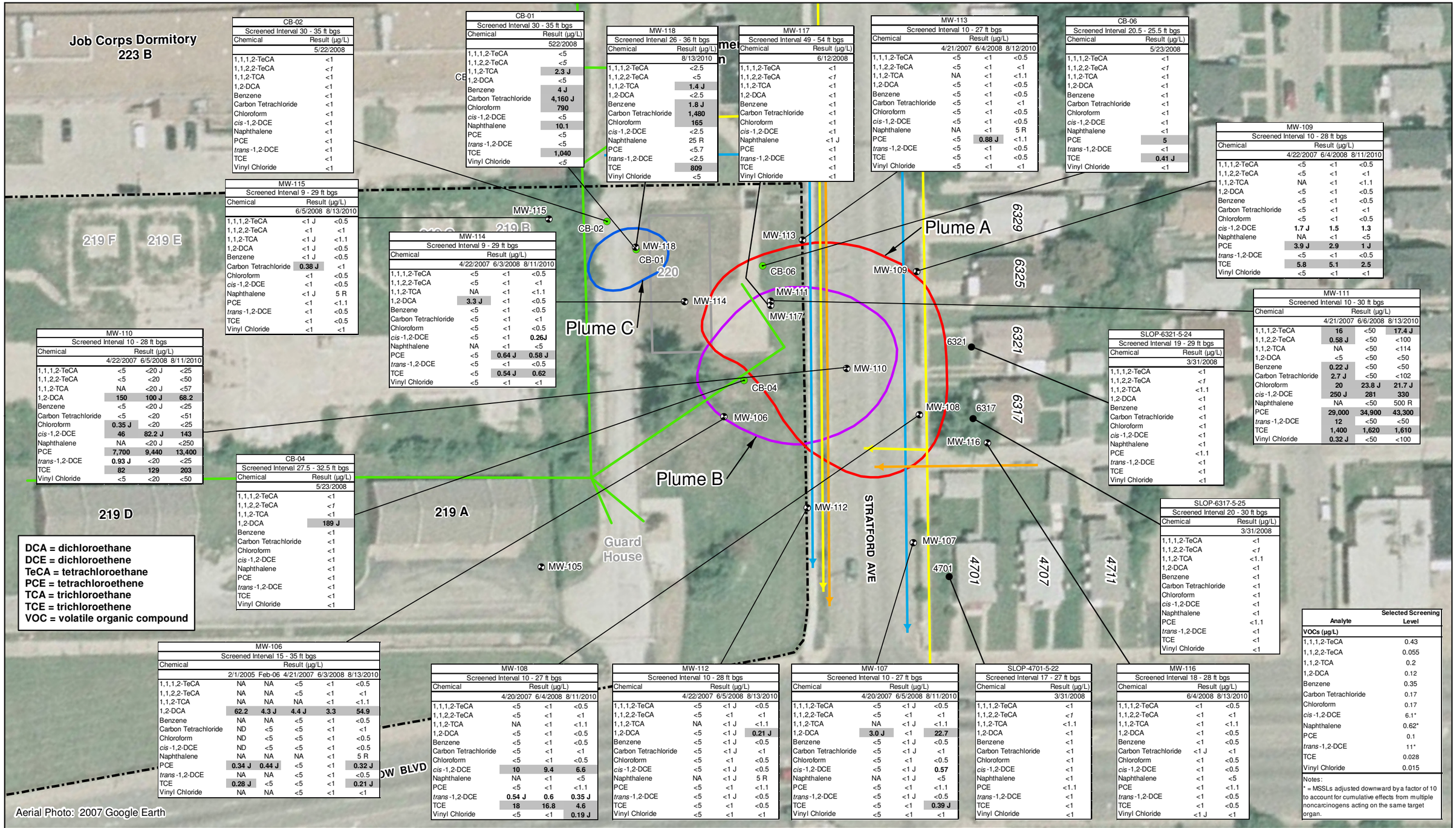
Approximate Utilities
- Natural Gas
- Sanitary Sewer
- Telephone
- Water

0 30 60 Feet

NOTES:
1. CT = carbon tetrachloride
2. *cis*-1,2-DCE = *cis*-1,2-dichloroethene
3. PCE = tetrachloroethene
4. TCE = trichloroethene
5. DCE = dichloroethene
6. D = Qualified at dilution
7. J - Estimated Concentration
8. NR = Not reported
9. '<' - Chemical not detected above the method detection limit
10. Bold type indicates the chemical was detected
11. Gray highlight indicates a detected concentration above the screening level.
12. ft bgs = feet below ground surface

FIGURE 2-9
VOCs IN SUBSURFACE SOIL AT CONCENTRATIONS EXCEEDING SCREENING LEVELS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL



CB-02 — Screened Interval 30 - 35 ft bgs

Chemical	Result (µg/L) 5/22/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

CB-01 — Screened Interval 30 - 35 ft bgs

Chemical	Result (µg/L) 522/2008
1,1,1,2-TeCA	<5
1,1,2,2-TeCA	*<5*
1,1,2-TCA	**2.3 J**
1,2-DCA	<5
Benzene	**4 J**
Carbon Tetrachloride	**4,160 J**
Chloroform	**790**
cis-1,2-DCE	<5
Naphthalene	**10.1**
PCE	<5
trans-1,2-DCE	<5
TCE	**1,040**
Vinyl Chloride	*<5*

MW-118 — Screened Interval 26 - 36 ft bgs

Chemical	Result (µg/L) 8/13/2010
1,1,1,2-TeCA	<2.5
1,1,2,2-TeCA	<5
1,1,2-TCA	**1.4 J**
1,2-DCA	<2.5
Benzene	**1.8 J**
Carbon Tetrachloride	**1,480**
Chloroform	**165**
cis-1,2-DCE	<2.5
Naphthalene	25 R
PCE	<5.7
trans-1,2-DCE	<2.5
TCE	**809**
Vinyl Chloride	<5

MW-117 — Screened Interval 49 - 54 ft bgs

Chemical	Result (µg/L) 6/12/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1 J
PCE	<1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

MW-113 — Screened Interval 10 - 27 ft bgs

Chemical	Result (µg/L) 4/21/2007	6/4/2008	8/12/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	<5	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1	<0.5
Naphthalene	NA	<1	5 R
PCE	<5	**0.88 J**	<1.1
trans-1,2-DCE	<5	<1	<0.5
TCE	<5	<1	<0.5
Vinyl Chloride	<5	<1	<1

CB-06 — Screened Interval 20.5 - 25.5 ft bgs

Chemical	Result (µg/L) 5/23/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	**5**
trans-1,2-DCE	<1
TCE	**0.41 J**
Vinyl Chloride	<1

MW-109 — Screened Interval 10 - 28 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/4/2008	8/11/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	<5	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	**1.7 J**	**1.5**	**1.3**
Naphthalene	NA	<1	<5
PCE	**3.9 J**	**2.9**	**1 J**
trans-1,2-DCE	<5	<1	<0.5
TCE	**5.8**	**5.1**	**2.5**
Vinyl Chloride	<5	<1	<1

MW-115 — Screened Interval 9 - 29 ft bgs

Chemical	Result (µg/L) 6/5/2008	8/13/2010
1,1,1,2-TeCA	<1 J	<0.5
1,1,2,2-TeCA	<1	<1
1,1,2-TCA	<1 J	<1.1
1,2-DCA	<1 J	<0.5
Benzene	<1 J	<0.5
Carbon Tetrachloride	**0.38 J**	<1
Chloroform	<1	<0.5
cis-1,2-DCE	<1	<0.5
Naphthalene	<1 J	5 R
PCE	<1	<1.1
trans-1,2-DCE	<1	<0.5
TCE	<1	<0.5
Vinyl Chloride	<1	<1

MW-114 — Screened Interval 9 - 29 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/3/2008	8/11/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	**3.3 J**	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1	**0.26J**
Naphthalene	NA	<1	<5
PCE	<5	**0.64 J**	**0.58 J**
trans-1,2-DCE	<5	<1	<0.5
TCE	<5	**0.54 J**	**0.62**
Vinyl Chloride	<5	<1	<1

MW-110 — Screened Interval 10 - 28 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/5/2008	8/11/2010
1,1,1,2-TeCA	<5	<20 J	<25
1,1,2,2-TeCA	<5	<20	<50
1,1,2-TCA	NA	<20 J	<57
1,2-DCA	**150**	**100 J**	**68.2**
Benzene	<5	<20 J	<25
Carbon Tetrachloride	<5	<20	<51
Chloroform	**0.35 J**	<20	<25
cis-1,2-DCE	**46**	**82.2 J**	**143**
Naphthalene	NA	<20 J	<250
PCE	**7,700**	**9,440**	**13,400**
trans-1,2-DCE	**0.93 J**	<20	<25
TCE	**82**	**129**	**203**
Vinyl Chloride	<5	<20	<50

CB-04 — Screened Interval 27.5 - 32.5 ft bgs

Chemical	Result (µg/L) 5/23/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1
1,2-DCA	**189 J**
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

MW-111 — Screened Interval 10 - 30 ft bgs

Chemical	Result (µg/L) 4/21/2007	6/6/2008	8/13/2010
1,1,1,2-TeCA	**16**	<50	**17.4 J**
1,1,2,2-TeCA	**0.58 J**	<50	<100
1,1,2-TCA	NA	<50	<114
1,2-DCA	<5	<50	<50
Benzene	**0.22 J**	<50	<50
Carbon Tetrachloride	**2.7 J**	<50	<102
Chloroform	**20**	**23.8 J**	**21.7 J**
cis-1,2-DCE	**250 J**	**281**	**330**
Naphthalene	NA	<50	500 R
PCE	**29,000**	**34,900**	**43,300**
trans-1,2-DCE	**12**	<50	<50
TCE	**1,400**	**1,620**	**1,610**
Vinyl Chloride	**0.32 J**	<50	<100

SLOP-6321-5-24 — Screened Interval 19 - 29 ft bgs

Chemical	Result (µg/L) 3/31/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1.1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1.1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

SLOP-6317-5-25 — Screened Interval 20 - 30 ft bgs

Chemical	Result (µg/L) 3/31/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1.1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1.1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

MW-106 — Screened Interval 15 - 35 ft bgs

Chemical	Result (µg/L) 2/1/2005	Feb-06	4/21/2007	6/3/2008	8/13/2010
1,1,1,2-TeCA	NA	NA	<5	<1	<0.5
1,1,2,2-TeCA	NA	NA	<5	<1	<1
1,1,2-TCA	NA	NA	NA	<1	<1.1
1,2-DCA	**62.2**	**4.3 J**	**4.4 J**	**3.3**	**54.9**
Benzene	NA	NA	<5	<1	<0.5
Carbon Tetrachloride	ND	<5	<5	<1	<1
Chloroform	ND	<5	<5	<1	<0.5
cis-1,2-DCE	ND	<5	<5	<1	<0.5
Naphthalene	NA	NA	NA	<1	5 R
PCE	**0.34 J**	**0.44 J**	<5	<1	**0.32 J**
trans-1,2-DCE	NA	NA	<5	<1	<0.5
TCE	**0.28 J**	<5	<5	<1	**0.21 J**
Vinyl Chloride	NA	NA	<5	<1	<1

MW-108 — Screened Interval 10 - 27 ft bgs

Chemical	Result (µg/L) 4/20/2007	6/4/2008	8/11/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	<5	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	**10**	**9.4**	**6.6**
Naphthalene	NA	<1	<5
PCE	<5	<1	<1.1
trans-1,2-DCE	**0.54 J**	**0.6**	**0.35 J**
TCE	**18**	**16.8**	**4.6**
Vinyl Chloride	<5	<1	**0.19 J**

MW-112 — Screened Interval 10 - 28 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/5/2008	8/13/2010
1,1,1,2-TeCA	<5	<1 J	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1 J	<1.1
1,2-DCA	<5	<1 J	**0.21 J**
Benzene	<5	<1 J	<0.5
Carbon Tetrachloride	<5	<1 J	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1 J	<0.5
Naphthalene	NA	<1 J	5 R
PCE	<5	<1	<1.1
trans-1,2-DCE	<5	<1 J	<0.5
TCE	<5	<1	<0.5
Vinyl Chloride	<5	<1	<1

MW-107 — Screened Interval 10 - 27 ft bgs

Chemical	Result (µg/L) 4/20/2007	6/5/2008	8/11/2010
1,1,1,2-TeCA	<5	<1 J	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1 J	<1.1
1,2-DCA	**3.0 J**	<1	**22.7**
Benzene	<5	<1 J	<0.5
Carbon Tetrachloride	<5	<1 J	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1 J	**0.57**
Naphthalene	NA	<1 J	<5
PCE	<5	<1	<1.1
trans-1,2-DCE	<5	<1 J	<0.5
TCE	<5	<1	**0.39 J**
Vinyl Chloride	<5	<1	<1

SLOP-4701-5-22 — Screened Interval 17 - 27 ft bgs

Chemical	Result (µg/L) 3/31/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1.1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1.1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

MW-116 — Screened Interval 18 - 28 ft bgs

Chemical	Result (µg/L) 6/4/2008	8/13/2010
1,1,1,2-TeCA	<1	<0.5
1,1,2,2-TeCA	<1	<1
1,1,2-TCA	<1	<1.1
1,2-DCA	<1	<0.5
Benzene	<1	<0.5
Carbon Tetrachloride	<1 J	<1
Chloroform	<1	<0.5
cis-1,2-DCE	<1	<0.5
Naphthalene	<1	<5
PCE	<1	<1.1
trans-1,2-DCE	<1	<0.5
TCE	<1	<0.5
Vinyl Chloride	<1 J	<1

Analyte	Selected Screening Level
VOCs (µg/L)	
1,1,1,2-TeCA	0.43
1,1,2,2-TeCA	0.055
1,1,2-TCA	0.2
1,2-DCA	0.12
Benzene	0.35
Carbon Tetrachloride	0.17
Chloroform	0.17
cis-1,2-DCE	6.1*
Naphthalene	0.62*
PCE	0.1
trans-1,2-DCE	11*
TCE	0.028
Vinyl Chloride	0.015

Notes:
* = MSSLs adjusted downward by a factor of 10 to account for cumulative effects from multiple noncarcinogens acting on the same target organ.

0 30 60 Feet

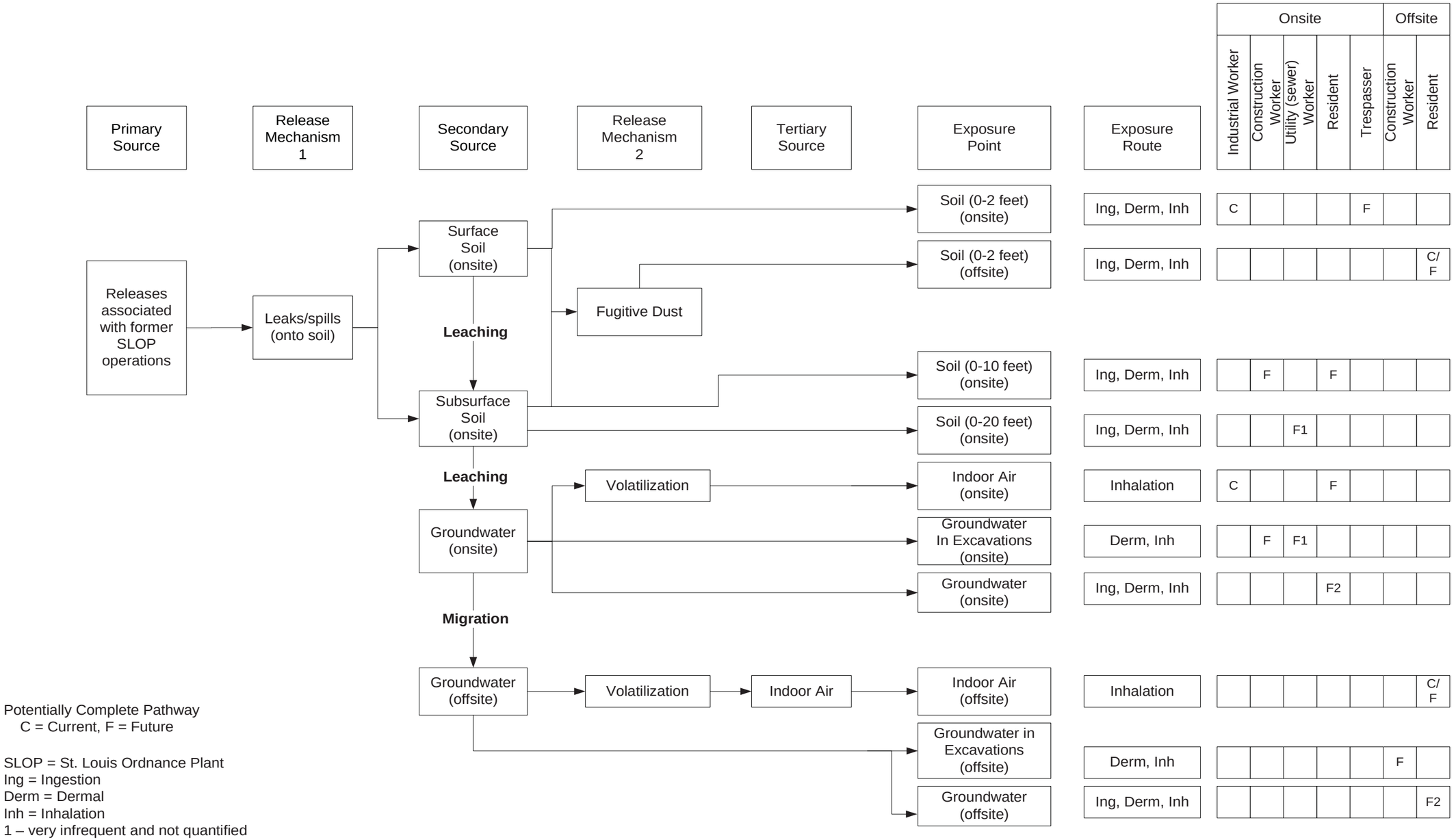
LEGEND
- Groundwater Sample Point
- Temporary Well
- Monitoring Well
- Site Boundary
- Former Building
- Area Exceeding MCL for PCE, TCE, and cis-1,2-DCE (Plume A)
- Area Exceeding MCL for 1,2-DCA (Plume B)
- Area Exceeding MCL for Carbon Tetrachloride (Plume C)

Approximate Utilities
- Natural Gas
- Sanitary Sewer
- Telephone
- Water

Notes
1. J = Estimated Concentration
2. '<' = Chemical not detected above the method detection limit
3. Bold type indicates the chemical was detected
4. Gray highlight indicates a detected concentration above the screening level.
5. µg/L = micrograms per Liter
6. R = Sample result rejected due to deficiencies in the ability to analyze the sample and to meet the quality control criteria.

FIGURE 2-10
VOCs IN GROUNDWATER AT CONCENTRATIONS EXCEEDING SCREENING LEVELS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri
CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-10_VOCS_GW_EXCEED_DD.MXD MSCHROCK 1/31/2011 19:52:42



Potentially Complete Pathway
C = Current, F = Future

SLOP = St. Louis Ordnance Plant
Ing = Ingestion
Derm = Dermal
Inh = Inhalation
1 – very infrequent and not quantified
2 – hypothetical future potable use

FIGURE 2-11
CONCEPTUAL SITE MODEL
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

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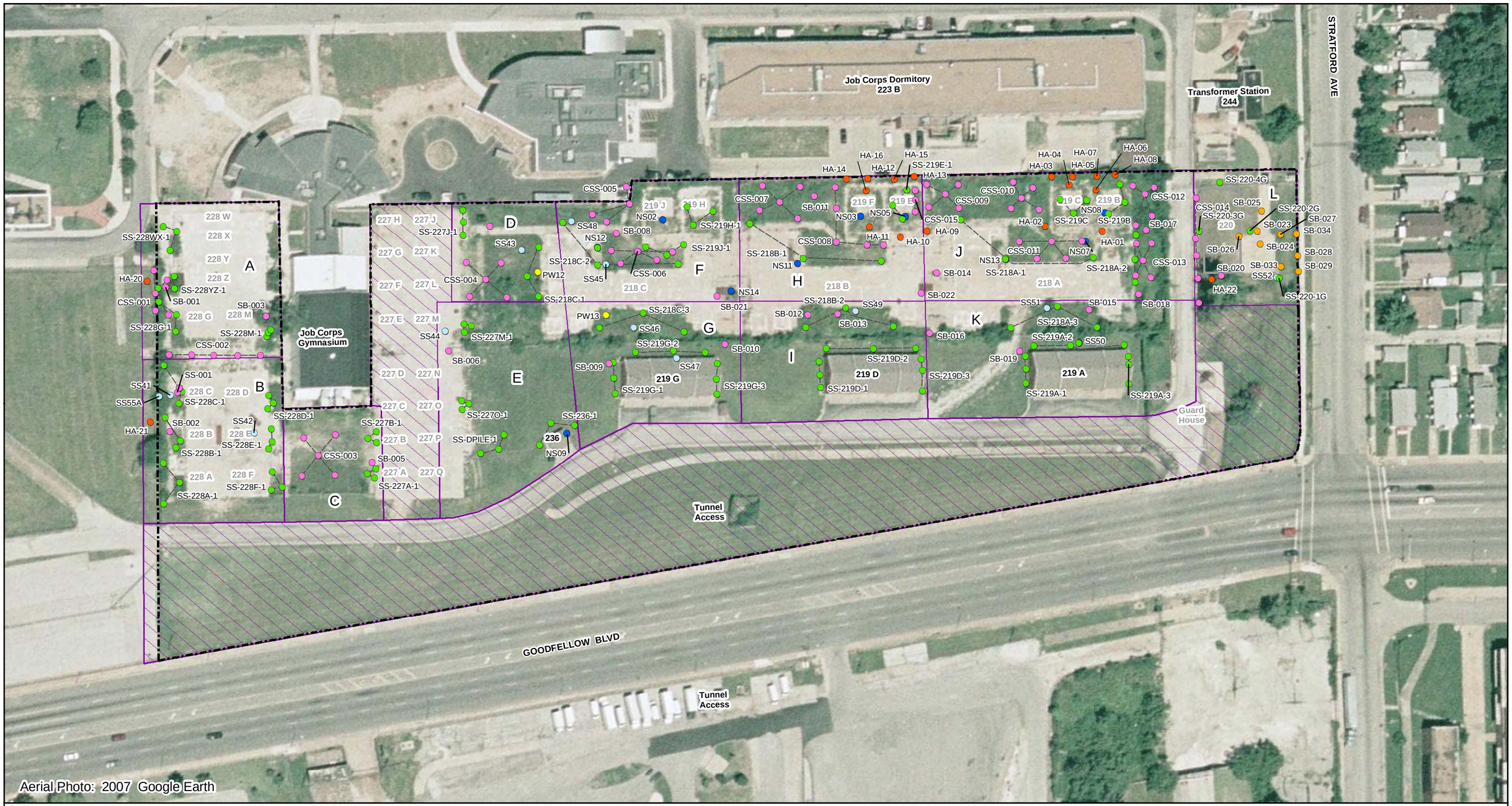

LEGEND

- 2008 Soil Sample
- 2005/2006 Soil Boring
- 2005 Soil Sample
- 2001 Soil Sample
- 2001 Powder Well
- 1998 Soil Sample Locations
- 1991 Soil Sample
- Composite Sample Portion Line
- 220 Former Building
- Exposure Unit
- Non-Exposure Unit
- Site Boundary

0 50 100 Feet

NOTES:
1. NS03 (0-1' bgs), NS08 (0-1' bgs), SS-001, SS218A-2, SS-219B, SS-219C, and SS55A not included in risk assessment.

FIGURE 2-12
SUBSURFACE SOIL EXPOSURE UNITS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

CH2MHILL

\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-12_EXPOSURE_UNITS_DD.MXD MSCHROCK 1/26/2011 22:45:32

SED-001	
0 - 1 ft bgs	
Analyte	Results
PCBs (mg/kg)	
Aroclor 1260	569

SS55A	
0 - 1 ft bgs	
Analyte	Results
PCBs (mg/kg)	
Aroclor 1260	18,200

SS-001	
0 - 1 ft bgs	
Analyte	Results
PCBs (mg/kg)	
Aroclor 1260	1.44

NS03	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	44
Lead	5,840

NS08	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	67.7

SS-219B	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	108

SS-218A-1	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	8.64 J

SS-218A-3	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Thallium	7.67 J

SS-219C	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Arsenic	68.8

SS-218A-2	
0 - 1 ft bgs	
Analyte	Results
Metals (mg/kg)	
Lead	2,724

Analyte	Remediation Goal (mg/kg)
Arsenic	13.2
Lead	400
Thallium	7
Aroclor 1260	1

Aerial Photo: 2007 Google Earth

LEGEND

- 2008 Soil Sample
- 2005 Soil Sample
- 2001 Soil Sample
- 1998 Soil Sample
- 1991 Soil Sample
- Powder Well
- Composite Sample Portion Line
- Site Boundary
- 220 Former Building
- Estimated Excavation Limits

0 50 100 Feet

NOTES:
1. J = Reported value is estimated.
2. mg/kg = milligrams per kilogram
3. The surface soil remedial action will not include areas covered with concrete.

FIGURE 2-13
SOIL REMOVAL AREAS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

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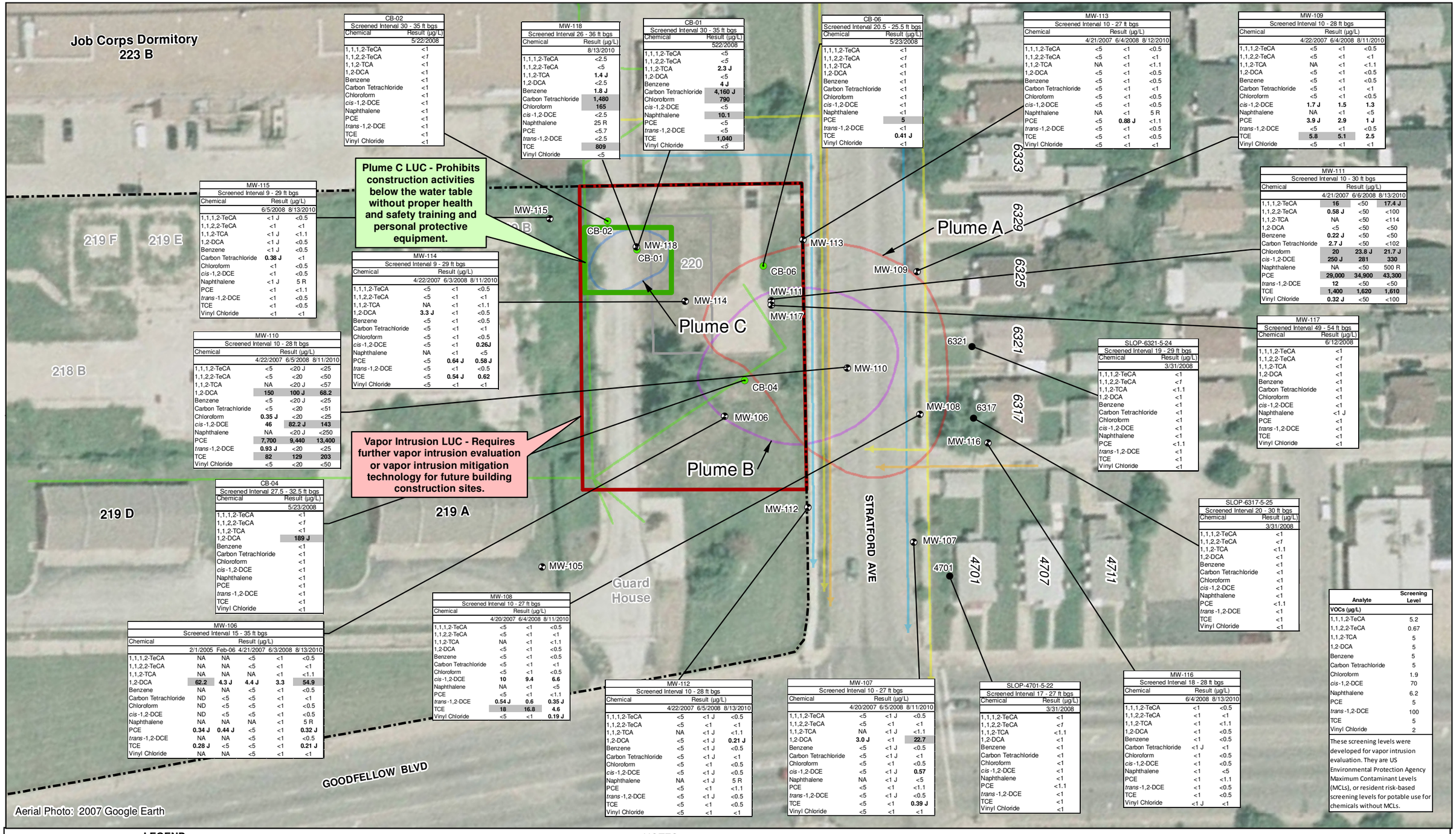
\\BALDUR\PROJ\SLOP_349765\MAPFILES\DEC_DOC\FIG_2-13_SOIL_REMOVAL_AREAS_DD.MXD MSCHROCK 12/2/2010 13:32:19



CB-02
Screened Interval 30 - 35 ft bgs

Chemical	Result (µg/L) 5/22/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	<1
1,1,2-TCA	<1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

MW-118
Screened Interval 26 - 36 ft bgs

Chemical	Result (µg/L) 8/13/2010
1,1,1,2-TeCA	<2.5
1,1,2,2-TeCA	<5
1,1,2-TCA	**1.4 J**
1,2-DCA	<2.5
Benzene	**1.8 J**
Carbon Tetrachloride	**1,480**
Chloroform	**165**
cis-1,2-DCE	<2.5
Naphthalene	25 R
PCE	<5.7
trans-1,2-DCE	<2.5
TCE	**809**
Vinyl Chloride	<5

CB-01
Screened Interval 30 - 35 ft bgs

Chemical	Result (µg/L) 522/2008
1,1,1,2-TeCA	<5
1,1,2,2-TeCA	*<5*
1,1,2-TCA	**2.3 J**
1,2-DCA	<5
Benzene	**4 J**
Carbon Tetrachloride	**4,160 J**
Chloroform	**790**
cis-1,2-DCE	<5
Naphthalene	**10.1**
PCE	<5
trans-1,2-DCE	<5
TCE	**1,040**
Vinyl Chloride	*<5*

CB-06
Screened Interval 20.5 - 25.5 ft bgs

Chemical	Result (µg/L) 5/23/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	**5**
trans-1,2-DCE	<1
TCE	**0.41 J**
Vinyl Chloride	<1

MW-113
Screened Interval 10 - 27 ft bgs

Chemical	Result (µg/L) 4/21/2007	6/4/2008	8/12/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	<5	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1	<0.5
Naphthalene	NA	<1	5 R
PCE	<5	**0.88 J**	<1.1
trans-1,2-DCE	<5	<1	<0.5
TCE	<5	<1	<0.5
Vinyl Chloride	<5	<1	<1

MW-109
Screened Interval 10 - 28 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/4/2008	8/11/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	<5	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	**1.7 J**	**1.5**	**1.3**
Naphthalene	NA	<1	<5
PCE	**3.9 J**	**2.9**	**1 J**
trans-1,2-DCE	<5	<1	<0.5
TCE	**5.8**	**5.1**	**2.5**
Vinyl Chloride	<5	<1	<1

MW-115
Screened Interval 9 - 29 ft bgs

Chemical	Result (µg/L) 6/5/2008	8/13/2010
1,1,1,2-TeCA	<1 J	<0.5
1,1,2,2-TeCA	<1	<1
1,1,2-TCA	<1 J	<1.1
1,2-DCA	<1 J	<0.5
Benzene	<1 J	<0.5
Carbon Tetrachloride	**0.38 J**	<1
Chloroform	<1	<0.5
cis-1,2-DCE	<1	<0.5
Naphthalene	<1 J	5 R
PCE	<1	<1.1
trans-1,2-DCE	<1	<0.5
TCE	<1	<0.5
Vinyl Chloride	<1	<1

MW-114
Screened Interval 9 - 29 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/3/2008	8/11/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	**3.3 J**	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1	**0.26J**
Naphthalene	NA	<1	<5
PCE	<5	**0.64 J**	**0.58 J**
trans-1,2-DCE	<5	<1	<0.5
TCE	<5	**0.54 J**	**0.62**
Vinyl Chloride	<5	<1	<1

MW-111
Screened Interval 10 - 30 ft bgs

Chemical	Result (µg/L) 4/21/2007	6/6/2008	8/13/2010
1,1,1,2-TeCA	**16**	<50	**17.4 J**
1,1,2,2-TeCA	**0.58 J**	<50	<100
1,1,2-TCA	NA	<50	<114
1,2-DCA	<5	<50	<50
Benzene	**0.22 J**	<50	<50
Carbon Tetrachloride	**2.7 J**	<50	<102
Chloroform	**20**	**23.8 J**	**21.7 J**
cis-1,2-DCE	**250 J**	**281**	**330**
Naphthalene	NA	<50	500 R
PCE	**29,000**	**34,900**	**43,300**
trans-1,2-DCE	**12**	<50	<50
TCE	**1,400**	**1,620**	**1,610**
Vinyl Chloride	**0.32 J**	<50	<100

MW-110
Screened Interval 10 - 28 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/5/2008	8/11/2010
1,1,1,2-TeCA	<5	<20 J	<25
1,1,2,2-TeCA	<5	<20	<50
1,1,2-TCA	NA	<20 J	<57
1,2-DCA	**150**	**100 J**	**68.2**
Benzene	<5	<20 J	<25
Carbon Tetrachloride	<5	<20	<51
Chloroform	**0.35 J**	<20	<25
cis-1,2-DCE	**46**	**82.2 J**	**143**
Naphthalene	NA	<20 J	<250
PCE	**7,700**	**9,440**	**13,400**
trans-1,2-DCE	**0.93 J**	<20	<25
TCE	**82**	**129**	**203**
Vinyl Chloride	<5	<20	<50

MW-117
Screened Interval 49 - 54 ft bgs

Chemical	Result (µg/L) 6/12/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1 J
PCE	<1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

SLOP-6321-5-24
Screened Interval 19 - 29 ft bgs

Chemical	Result (µg/L) 3/31/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1.1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1.1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

CB-04
Screened Interval 27.5 - 32.5 ft bgs

Chemical	Result (µg/L) 5/23/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1
1,2-DCA	**189 J**
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

MW-106
Screened Interval 15 - 35 ft bgs

Chemical	Result (µg/L) 2/1/2005	Feb-06	4/21/2007	6/3/2008	8/13/2010
1,1,1,2-TeCA	NA	NA	<5	<1	<0.5
1,1,2,2-TeCA	NA	NA	<5	<1	<1
1,1,2-TCA	NA	NA	NA	<1	<1.1
1,2-DCA	**62.2**	**4.3 J**	**4.4 J**	**3.3**	**54.9**
Benzene	NA	NA	<5	<1	<0.5
Carbon Tetrachloride	ND	<5	<5	<1	<1
Chloroform	ND	<5	<5	<1	<0.5
cis-1,2-DCE	ND	<5	<5	<1	<0.5
Naphthalene	NA	NA	NA	<1	5 R
PCE	**0.34 J**	**0.44 J**	<5	<1	**0.32 J**
trans-1,2-DCE	NA	NA	<5	<1	<0.5
TCE	**0.28 J**	<5	<5	<1	**0.21 J**
Vinyl Chloride	NA	NA	<5	<1	<1

MW-108
Screened Interval 10 - 27 ft bgs

Chemical	Result (µg/L) 4/20/2007	6/4/2008	8/11/2010
1,1,1,2-TeCA	<5	<1	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1	<1.1
1,2-DCA	<5	<1	<0.5
Benzene	<5	<1	<0.5
Carbon Tetrachloride	<5	<1	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	**10**	**9.4**	**6.6**
Naphthalene	NA	<1	<5
PCE	<5	<1	<1.1
trans-1,2-DCE	**0.54 J**	**0.6**	**0.35 J**
TCE	**18**	**16.8**	**4.6**
Vinyl Chloride	<5	<1	**0.19 J**

MW-112
Screened Interval 10 - 28 ft bgs

Chemical	Result (µg/L) 4/22/2007	6/5/2008	8/13/2010
1,1,1,2-TeCA	<5	<1 J	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1 J	<1.1
1,2-DCA	<5	<1 J	**0.21 J**
Benzene	<5	<1 J	<0.5
Carbon Tetrachloride	<5	<1 J	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1 J	<0.5
Naphthalene	NA	<1 J	5 R
PCE	<5	<1	<1.1
trans-1,2-DCE	<5	<1 J	<0.5
TCE	<5	<1	<0.5
Vinyl Chloride	<5	<1	<1

MW-107
Screened Interval 10 - 27 ft bgs

Chemical	Result (µg/L) 4/20/2007	6/5/2008	8/11/2010
1,1,1,2-TeCA	<5	<1 J	<0.5
1,1,2,2-TeCA	<5	<1	<1
1,1,2-TCA	NA	<1 J	<1.1
1,2-DCA	**3.0 J**	<1	**22.7**
Benzene	<5	<1 J	<0.5
Carbon Tetrachloride	<5	<1 J	<1
Chloroform	<5	<1	<0.5
cis-1,2-DCE	<5	<1 J	**0.57**
Naphthalene	NA	<1 J	<5
PCE	<5	<1	<1.1
trans-1,2-DCE	<5	<1 J	<0.5
TCE	<5	<1	**0.39 J**
Vinyl Chloride	<5	<1	<1

SLOP-4701-5-22
Screened Interval 17 - 27 ft bgs

Chemical	Result (µg/L) 3/31/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1.1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1.1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

SLOP-6317-5-25
Screened Interval 20 - 30 ft bgs

Chemical	Result (µg/L) 3/31/2008
1,1,1,2-TeCA	<1
1,1,2,2-TeCA	*<1*
1,1,2-TCA	<1.1
1,2-DCA	<1
Benzene	<1
Carbon Tetrachloride	<1
Chloroform	<1
cis-1,2-DCE	<1
Naphthalene	<1
PCE	<1.1
trans-1,2-DCE	<1
TCE	<1
Vinyl Chloride	<1

MW-116
Screened Interval 18 - 28 ft bgs

Chemical	Result (µg/L) 6/4/2008	8/13/2010
1,1,1,2-TeCA	<1	<0.5
1,1,2,2-TeCA	<1	<1
1,1,2-TCA	<1	<1.1
1,2-DCA	<1	<0.5
Benzene	<1	<0.5
Carbon Tetrachloride	<1 J	<1
Chloroform	<1	<0.5
cis-1,2-DCE	<1	<0.5
Naphthalene	<1	<5
PCE	<1	<1.1
trans-1,2-DCE	<1	<0.5
TCE	<1	<0.5
Vinyl Chloride	<1 J	<1

Analyte	Screening Level
VOCs (µg/L)	
1,1,1,2-TeCA	5.2
1,1,2,2-TeCA	0.67
1,1,2-TCA	5
1,2-DCA	5
Benzene	5
Carbon Tetrachloride	5
Chloroform	1.9
cis-1,2-DCE	70
Naphthalene	6.2
PCE	5
trans-1,2-DCE	100
TCE	5
Vinyl Chloride	2

These screening levels were developed for vapor intrusion evaluation. They are US Environmental Protection Agency Maximum Contaminant Levels (MCLs), or resident risk-based screening levels for potable use for chemicals without MCLs.

LEGEND

- Groundwater Sample Point
- Temporary Well
- Monitoring Well
- Plume C LUC
- Vapor Intrusion LUC
- 220 Former Building

Approximate Utilities
- Natural Gas
- Sanitary Sewer
- Telephone
- Water
- Site Boundary

- Area Exceeding MCL for 1,2-DCA (Plume B)
- Area Exceeding MCL for Carbon Tetrachloride (Plume C)
- Area Exceeding MCL for PCE, TCE, and cis-1,2-DCE (Plume A)

0 30 60 Feet

NOTES:
1. VOC = volatile organic compound
2. TeCA = tetrachloroethane
3. TCA = trichloroethane
4. DCA = dichloroethane
5. DCE = dichloroethene
6. PCE = tetrachloroethene
7. TCE = trichloroethene
8. J = Estimated Concentration
9. < = Chemical not detected above the method detection limit
10. Bold type indicates the chemical was detected
11. Shading indicates a detected concentration above the screening level
12. Italicized values represent detection limits above screening levels
13. µg/L = micrograms per liter

FIGURE 2-14
LAND USE CONTROL BOUNDARIES
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

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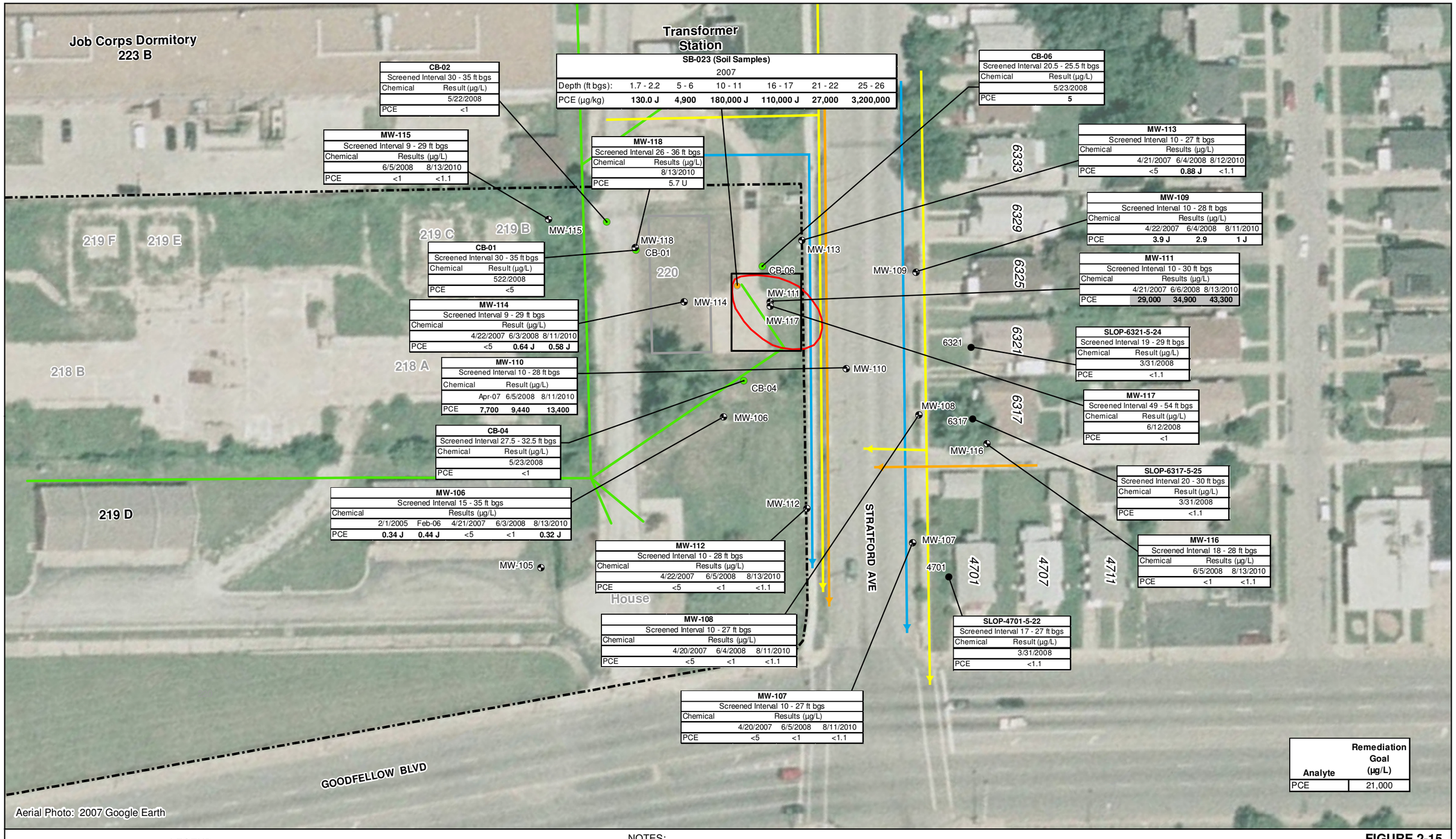

LEGEND

- Groundwater Sample Point
- Temporary Well
- Soil Boring
- Monitoring Well

Approximate Utilities
- Natural Gas
- Sanitary Sewer
- Telephone
- Water

- Area Exceeding the Construction Worker PRG
- Target Treatment Zone/ Excavation Extents
- 220 Former Building
- Site Boundary

0 30 60 Feet

NOTES:
1. The PRG is protective of construction worker exposure.
2. COC = chemical of concern
3. PCE = tetrachloroethene
4. J = Estimated Concentration
5. < = Chemical not detected above the method detection limit
6. Bold type indicates the chemical was detected.
7. Shading indicates a detected concentration above the construction worker PRG.
8. µg/L = micrograms per liter
9. µg/kg = micrograms per kilogram

FIGURE 2-15
COCs IN GROUNDWATER AT CONCENTRATIONS EXCEEDING REMEDIATION GOALS
St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

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3. Responsiveness Summary

The public comment period for the former Hanley Area began on November 29, 2010, and ended on December 29, 2010. No comments were received on the Proposed Plan. The public availability session regarding the Proposed Plan was held on December 13, 2010. No comments or questions were received from the public during the public comment period or at the public availability session.

3.1 Stakeholder Comments and Lead Agency Responses

None.

3.2 Technical and Legal Issues

None.

4. References

Agency for Toxic Substances and Disease Registry. 2005. *Toxicological Profile for 1,2-Dichloroethane.* August.

CH2M HILL, Inc. 2008. Work Plan. *Remedial Investigation Report, St. Louis Ordnance Plant, Former Hanley, St. Louis.* Missouri. May.

CH2M HILL. 2009. *Final Remedial Investigation, St. Louis Ordnance Plant, Former Hanley, St. Louis, Missouri.*

CH2M HILL. 2010. *Final Feasibility Study Report, St. Louis Ordnance Plant, Former Hanley, St. Louis, Missouri.*

HARZA Environmental Services, Inc. 1998. *Site Investigation Report, Former St. Louis Ordnance Plant (SLOP), St. Louis, Missouri.*

Pangea Inc. 2003. *Phase I Environmental Site Assessment. Former St. Louis Ordnance Plant, 6400 Stratford Ave., St. Louis, Missouri.*

SCS Engineers. 2004. *Pre-Demolition Environmental Site Investigation Report, St. Louis Ordnance Plant.*

SCS Engineers. 2007. *Building 220, Guard House, and Harboad Street Bridge Demolition and Site Restoration Report.* May.

Shaw Environmental, Inc. 2003. *Limited Phase II Environmental Assessment Report for the Investigation of Impacted Groundwater, U.S. Army Reserve Center 4301 Goodfellow Blvd. St. Louis, Missouri.*

St. Louis Planning and Urban Design Agency. 2009. *St. Louis Strategic Land Use Plan.* http://stlcin.missouri.org/landuse/map.cfm?globalpointx=886571.442429&globalpointy=1042392.7517&extent=2750.

TapanAm Associates, Inc. 2001. Preliminary *Assessment/Site Inspection Report for Former St. Louis Ordnance Plant, St. Louis County. Missouri.*

Tidball, R. R. 1984. *Geochemical Survey of Missouri*. Geological Survey Professional Paper. 954-H, I.

URS Group, Inc. 2004. Site-Specific Environmental Baseline Survey, St. Louis Army Ammunition Plant, St. Louis Missouri.

U.S. Army Corps of Engineers (USACE). 2005. Technical Memorandum—Final Hanley Area Phase I Remedial Investigation, Former St. Louis Ordnance Plant, St. Louis. Missouri.

USACE. 2006a. Final Supplemental Groundwater Remedial Investigation Technical Memorandum, Hanley Area, Former St. Louis Ordnance Plant, St. Louis. Missouri. October 2.

USACE. 2006b. Final Supplemental Groundwater Phase II Remedial Investigation Addendum #4, Hanley Area, Former St. Louis Ordnance Plant, St. Louis. Missouri. December.

USACE. 2007. Final Supplemental Soil and Groundwater Phase II Remedial Investigation Technical Memorandum, Hanley Area, Former St. Louis Ordnance Plant, St. Louis. Missouri. June 25.

U.S. Army Toxic and Hazardous Materials Agency (USATHAMA)—Battelle Columbus Laboratories. 1981. *Survey of Hazardous/Chemical Area No. 2 of the Former St. Louis Ordnance Plant, Volumes I and II, Final Report.*

USATHAMA—ICF Technology, Inc. 1991. *St. Louis Ordnance Plant Environmental Study, Status Report, Final Document.*

U.S. Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)*. USEPA/540/1-89/002.

USEPA. 1991. *A Guide to Principal Threat and Low Level Threat Wastes*. Office of Solid Waste and Emergency Response. Publication 9380.3-06FS. November.

USEPA 1996. *Soil Screening Guidance: User's Guide.* Office of Solid Waste and Emergency Response. EPA/540/R-96/018.

USEPA. 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). Federal Register,* Vol. 67, No. 230. pp. 71169–72.

USEPA. 2003. *Human Health Toxicity Values in Superfund Risk Assessments.* OSWER Directive 9285.7-53. December 5.

USEPA. 2008. Eco-SSL. Last updated May 21, 2008. http://www.epa.gov/ecotox/ecossl/.